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CIVIL ENGINEERING.

*Remarks upon the Cost of Repairs of Locomotive Engines. (Written January, 1849.)**

Continued from page 84.

Having thus given the result as taken upon an extreme amount of mileage, I will proceed to show the calculation upon a more moderate amount of work.

I have before observed (note § p. 81) that I don't think any engine ever did run 300,000 miles in 10 years. Innumerable unforeseen circumstances may occur to detain her, some unexpected casualty may stop her at a time when it is inconvenient to turn her into the "Hospital" to repair—three or four days will pass, or a week, and when it is fairly taken in hand, many incidents may again occasion delay.† I will, therefore, relieve her of 50,000 miles in the 10 years, and assume her gross mileage run to be a quarter of a million—say 250,000 miles, which I think might be done without very much difficulty. Upon this I will take the last computation, when we assumed the renewing system to be adopted,—viz., 2½d. per mile run for current repairs.

† Among others may be enumerated—1st, The fact that the defect not unfrequently proves to be more serious than was expected—2nd, The having to wait for some special material to replace a broken part—3dly, It not unfrequently happens, that when a particular job is put into the hands of the best workmen, they will the next day absent themselves drinking, and be off work two or three days. In very special jobs, of course, others may be put in their places, but generally speaking, it is a bad policy to put one man's work into the hands of another. It frequently lays the foundation of disorganization and disquietude among workmen, the result of which is serious, to a degree almost incredible.

* From the London Railway Journal, for November, 1850.

The account will then stand thus:—

2½d. per mile on 250,000 miles, say	£2600
Deduct the same charge for fire-boxes and tubes as in the former case*	1100
Balance	£1500

This amount of £1500 has to be divided, as before, into allowances for casual current repairs for 10 years, and four thorough repairs—viz., one at the end of every 50,000 miles, or 20 months running. When I assumed 60,000 miles for 20 months work, I appropriated 425*l.* for 10 years for casualties. Having reduced the mileage 5000 miles per annum, I will make a proportionate reduction of this charge, and call it 360*l.* for incidental repairs during the 10 years, leaving 1140*l.* for four thorough repairs, or 285*l.*† every 50,000 miles run, to put her in proper order for resuming *another*.

Assuming that she is "kept going" at this rate of expenditure, and that by spinining out her distance for the last 20 months, into two years, as before remarked, (note § p. 83,) she gets through her work of 250,000 miles in 10 years. *I assert*, that if offered for sale, she would not realize more than was supposed in the previous case of expending 400*l.* every 60,000 —viz., 400*l.*,‡ and therefore, to replace her at the end of her supposed "*life*," with a new engine, we must have an account as follows:—

By credit of old engine	£400
Reserve of 1¼d. per mile beyond current expenditure on 250,000 miles	1822
Assumed bank interest on reserve fund	215
Balance required beyond 1¼d. per mile	63
	£2500

Thus showing that if she get through the fair work of a quarter of a million of miles in 10 years, a current expenditure of 2½d. per mile, and a reserve fund of upwards of 1¾d. per mile, or a clear total of upwards of 4¼d. per mile, must be appropriated to replace her with a new engine at the end of 10 years.

Let us now view the other side of the question as before—viz., that it be intended to *maintain the original engine*, and to turn her out fully repaired after running 250,000 miles, in 10 years, to commence a similar period of work.

I charge her first of all with 1375*l.* as before for tubes and fire-boxes, I will next allow 90*l.* every 20 months' work, in work, for incidental re-

* It may appear strange that the same charge should be made for these items, with 15 per cent. less work done. I premised that it was almost more than possible that the other amount of work *could* be done, and I now put this as a fair allowance for this distance. I would also remark that much advantage is gained by renewing a fire-box and tubes *early enough*, the loss incurred by letting them run too long is incalculable.

† This amount cannot but be admitted to be a minimum. I have relieved her of work, but cost does not decrease quite in the same ratio on the large amount of work assumed. She may be kept going at this sum, but her sale at the end of 10 years will be fully as doubtful as in the other case.

‡ The truth of this parallel may be questioned on account of the less wear and tear from the less quantity of work done. Be it remembered, that though the work be less, the gross allowance of money is proportionably less, and that at last it will be a case of selling.

pairs,* and say, 2150*l.* to be divided into five thorough repairs—viz., four of 400*l.* each during her 10 years servitude, and 550*l.* for the last, to prepare her to commence her new career.†

The accounts for 10 years will then stand thus:—

Fire-boxes and tubes	£1375
£90 every two years for casualties	450
Four thorough repairs at £400 each	1600
One final ditto at £550	550
	£3975

Showing a gross cost of 3975*l.* on a quarter of a million of miles run, or a small fraction more than 3¾d. per mile, or still an advantage of at least ¼d. per mile run in favor of *maintaining* stock in preference to *renewing* it.

I have assumed throughout that the engine has always a fair load to draw, and therefore we see, that in addition to the obvious *direct* advantage we have also a benefit to accrue *indirectly*. In the one case, the engine being always in perfect condition, will take her load *as she ought to do*. In the other case, being gradually wearing down, she will lose power in proportion, and involve a consequent loss of many pounds sterling to the Company by taking diminished loads.

It is plain from the above result, that under the best circumstances a clear amount *for repairs* of at least 3½d. per train per mile, must be expended upon engines, if they are to be properly maintained *without* depreciation, but that if the stock is to be relieved by the occasional substitution of new engines, a charge of 4d. per mile is involved, and as a railway Proprietor I submit that no board of Directors is justified in adopting the latter system, and thereby sacrificing ½d. per mile, which would otherwise go to the increase of dividend.

It is argued by some parties, that, by substituting new engines, advantage may be taken of improvements which from time to time may be made in their construction. When traffic increased so rapidly, as to render it necessary to adopt *a larger* class of engine, this argument was in a slight degree well grounded; but it has now been for some time known to what extent power and weight can be economically carried, and as to minor improvements, who is, or who ought to be, better qualified to project or carry them out cheaply than the Company's superintendent himself? who sees day by day the engines working, and has hourly opportunity of marking defects where there are any. Moreover, there are very many engines of old construction which might be materially enlarged at a less cost than buying new ones, and if the Company have not the means of doing it in their own workshops, they should send them to some first rate manufacturer and get them done.

* It will be remembered, that in computing the cost of "*renewing*," I made a reduction from £425 on 300,000 miles to £360 on 250,000 for incidental repairs. In the case of maintaining I only reduce from £500 to £450. This lessens my amount applicable to thorough repairs in a trifling ratio more than the other, but I well know that the difference properly spent in occasional repairs will make a proportionate difference on thorough repairs.

† I believe that *in practice* this would be found more than enough, and that 3½d. per mile would still be found sufficient to keep her "*up to the mark*" at 25,000 miles a year. I have, however, been liberal to avoid the charge of being prejudiced, and am convinced that the amounts named for maintaining (provided an engine runs the distance), will, at the end of 10 years, turn out as well made an engine as any manufacturer would supply.

I have yet to learn the advantage of selling an engine and tender for 400*l.* even though it required 100*l.* or more to refit her. 400*l.* is her *marketable* value; but her *effective* value, I hold to be, her prime cost of 2500*l.* less the amount required to repair her. There are plenty of stationary engines, which have been working in mills and elsewhere for half a century, and which, if there be no special demand for additional power, will continue to do so to the end of time, efficiently as at first. I apprehend that the owners of such engines would be considered as verging on insanity, were they to pull out the old one and put in a new one for pure moonshine. The case of locomotives is a parallel one, except that in the one case, the private individuals would be doing as they liked with their own, and in the other, the Directors would be spending the money of other people.

I think I have thus shown, that the practicability of maintaining stock is not only not impossible, but that it is decidedly the most economical system to pursue.

I will now make a few brief remarks on "depreciation;" and in the first place I would refer to a former remark, where *I deny* that any Company can substantiate the assertion that depreciation does not exist.

The question of depreciation has frequently been a subject of discussion at the periodical meetings of Railway Companies, and there have been a *pro* and an *anti*-depreciation fund party. The Directors and those officers whose positions require them to assist at such meetings, have almost invariably opposed the adoption of such a fund, and have given as their reason their unqualified belief, that the stock was *all* in full and effective order, and that *it could not* be better. Now, the fact is this: As long as the trains keep good time and the whole traffic is kept punctually going, the Directors generally and *the officers above alluded to* naturally suppose and believe that "all's right," and that the engines are well up to the mark, and in first rate order. But as to THE REALITY, let me ask, how a Secretary or *General Manager* (unless he be a bred engineer) can for a moment be supposed capable of judging whether an engine be worth 500*l.* or 2500*l.*? A bank clerk might as well be supposed to pronounce at a glance the value of a line of battle ship, or a soldier of a cast iron bridge.

It is further argued by the anti-fund party, that there is no clue by which to arrive at the amount required, and thus the fear of voting too great a sum, together with the lack of "fixity of tenure" which exists in all joint stock companies, have overruled the point, and every tangible farthing has been voted by the then existing proprietary to dividend.

It is the locomotive superintendents alone who can answer the comprehensive question, "*Is your house in order?*" and I would just ask any one of these officers on the leading railways of this country, "Where are *all* the engines that did the work of the line from 1840 to 1846, and in what condition are they *all* at the present time?" Let the secretary first state the prime cost of them, and also to what amount *revenue* has been debited for *new ones to replace old* since then, and then let the answers to those two questions be taken as proof whether any depreciation has existed or not.

Again, three years ago, when every old engine that could be made to move, was called into request, there was a general crying chorus, "We are sadly short of engines," "Many are working double shifts," "We can't get new ones half fast enough." Now let me ask, what proportion of branch lines have been opened since that date? I know that an extraordinary number of new engines, of the heaviest calibre, *have been delivered*, and although traffic has *decreased in proportion*, we have still the old cry, "We have not one engine to spare." I dare say this is the truth; but why is it so? Where are the veterans that tugged through the unparalleled traffic of 1845 and 1846, and the early part of 1847? Many of course are still at work. But where are the others? Some here and some there on sidings, or where any corner can be found to stow them. And why is this? The fact is, that till about two years and a half ago, the whole stock of engines was so completely occupied that there was not time to give them thorough repairs. They were patched and kept going as well as circumstances would permit, at a strained cost of say 2d. or 2½d. per mile, and day by day rapidly depreciating, and, had not relief come, the traffic must have been most irregularly worked, if not to some extent suspended. Relief, however, did come, but whence? A rapid delivery of powerful new engines commenced, and continued for several half-years, and though *nominally ordered for branches*, they *were put to work*, and *still work* the chief *bulk of the traffic on the main lines.*

These engines were of course paid for out of *capital*, and they went to devote the prime of their efficiency to the relief of their *over-worked* stock. *But, was that old stock gradually taken into the hospital to be systematically and thoroughly repaired?* And *will it be all completely refitted and ready in its turn to "return the compliment," and relieve the engines which relieved it?* I don't hesitate to assert that *such has not been the case* to the extent, or nearly so, that it ought to have been. When the oldest engines were relieved they ought to have been regularly brought in for thorough refitting, and the expenditure of 2d. or 2½d. per mile, charged to *revenue*, should have been *honestly increased* to 3½d. or 3¾d.; and I affirm, that, if a further demand is not to be made upon *capital* for the ill-judged purpose of "*indirect relief*," that sum must inevitably be expended out of earnings, *or*, at least, 1½d. per train per mile on every engine be "*funded*" to pay for *relays of new* engines.

There is yet another light in which to view depreciation, which, though I am an advocate for the entire erasion of the term from the railway vocabulary, should be mentioned and explained. Suppose, for instance, 10 new engines be delivered to a Company on the 1st of January, and run every day that month, they will in *effective value* (having brought all their working parts to an easy bearing) be worth more to the Company on the 1st of February than when first delivered; *but* they *would not sell for what they cost.* This *diminution in marketable value* (which must always exist between actual *new* and second-hand articles, and would probably be no more at the end of 12 months than at the end of four weeks,) is not, I think, a kind of depreciation for which provision should be made, though private owners of machinery *do* allow it at their first stock taking. I have main-

tained that *generally* as regards railways it should not be a current increasing item, and will, therefore, not insist that a demand should be made for first diminution in marketable value; reversing the proverb, I will "swallow the gnat," but I must decidedly "strain at," or rather decline altogether, to "swallow the camel."

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*Notes on Steam Navigation on Shallow Rivers, being the result of eighteen years' experience on the Loire and Garonne, by a Practical Engineer.**

In the year 1827, some engines having been constructed in Liverpool for steamers to run on the Loire, I was sent out to superintend the fitting and working of the boats, and arrived at Nantes on the 25th of May, 1827. I had only been there two months when the boats were all stopped, owing to the shallowness of the water. The first year I did not think much about it, but the second, I began to think that something could be done to remedy this serious evil; but I was told by everybody that there was no help for it. I was not, however, of their opinion, and my first job was to make a high pressure boiler, to replace one of Fawcett's, and which I patented. This boiler was of a cylindrical form, with D shaped flues, and weighed one ton less than the old one, which weighed 5 tons and worked at 4 lbs. per square inch. By the increased pressure, 24 lbs. per square inch, which this boiler would carry with safety, the power of the engine was nearly doubled, and the speed of the boat much increased. A very strong opposition had been started against our company by a rival company, which had got engines from Barnes and Miller of London, and their boats previously beat ours by an hour, and took all the traffic from us. With the new boiler we beat them by an hour and a half, and the opposition was soon over. This was in 1830. In 1831, I made a 24-horse engine for a boat that had a 12-horse engine in, previously, but the new engine was lighter than the old one. I carried 30 lbs. pressure in the boiler, and by making the condenser larger than usual, and keeping the air pump the ordinary size, I found I could get as good a vacuum as in a low pressure engine. In 1832, I began to think seriously about building light iron steamers, for the boats were all stopped about three months every summer, and at the very time when most money was to be made. But in this attempt I was worse off than Noah, for I had no one to give me the least instruction how to draught, or calculate, or build a boat, but I thought I would try; so I began by displacing a cubic foot of water and weighing it, and then I weighed a square foot of sheet iron, and a lineal foot of iron for the ribs. Then I made models and put them afloat, and worked on in this way the most part of 1832. In the beginning of 1833 I found that I could build a boat that would draw only eight inches of water, but I told the company nine inches, but they would not risk any money on it; so I spoke to some of my friends about it, and in three months we had the affair all settled. However, when the company got to know of it, they came forward, and would have an interest in it. At first we thought that we should be better without them, but to our misfortune we did not stop in that mind, for we found out, when it was too late, that they only did

* From the London Artizan, for January, 1851.

it, to keep our company from prospering, and by their intrigues they succeeded in doing so. I tried the engine on Christmas Day, and on New Year's Day we ran the boat about four leagues. She was drawing only six inches of water, but had nothing in her, except the engines, and boilers, and about a ton of coals. To give a better idea of the boat, I will describe her construction. Length, 100 feet; breadth, 10 feet 5 inches. The sheet iron she was built of was one-eleventh of an inch thick, the ribs 3 lbs. to the lineal foot, and two feet apart. The sides of the boat 3 feet 6 inches high, and where the engines were, 5 feet 6 inches. The iron for the paddle boxes, etc., was as light as I could get it. The cabins were made with strong canvas, with a light wood framing; the outside was well tarred, and the inside lined with fine cloth. Fore and aft the cabins there was a kind of platform, where the passengers could enjoy the air, under an awning. Where the cabins were, there was a small gangway, outside the boat, for the men to pass fore and aft without going through the cabins. The engine was a beam engine, of 24-horse power, with sheet iron beams, made very thin and deep. In like manner every advantage was taken to use wrought iron for strength and lightness. Diameter of cylinder 16 inches, and 2 feet stroke. Paddle wheels 12 feet diameter, 4 feet wide. Number of revolutions per minute, 43. Vacuum, 24 inches. Pressure of steam 38 lbs. on the square inch. The engine, boiler, shafts, and wheels weighed 6 tons, and the boat and the engine complete, 14 tons.

We started with her for Orleans on the 24th of March, 1834, when there was only 8 inches of water, and the novelty of this circumstance caused it to be remarked on by the various newspapers. She ran for some time, between Tours and Orleans, and when the boats that ran from Nantes to Angers were stopped for want of water, she was put upon the latter station, and very soon repaid the owners her cost. I was then commissioned to build a boat, 125 feet long by 14 feet beam, but before she was laid down, the American consul came to us with the plan of a boat on quite a new system, and this is it: Four cones put base to base; two together, and 13 feet apart. They were 6 feet diameter in the middle, and 90 feet long, making, when together, 180 feet in length. The cabin, engine, boilers, etc., were built on a platform supported on the cones, and the paddle wheel, which was 14 feet diameter and 12 feet wide, was in the centre, between the cones. She had a pair of engines of 20 horse power each, but she disappointed their expectations as to speed, so they returned to my plan. I took the two engines and built two light boats for them, with decks fore and aft; otherwise, and in the strength of the iron, they resembled the first one. The deck planks were $\frac{5}{8}$ of an inch thick; deck beams 2 inches $\times$ $1\frac{1}{2}$ inches, and placed 2 feet apart, with two rows of light columns inside. The deck was covered with strong canvas, for it would not stand caulking. These boats were 125 feet long and 10 feet broad, and drew 10 inches of water. I then thought I would try and make some use of the cones, as they were made of sheet iron; so I went to work and converted them into a boat 140 feet long and 13 feet broad. I changed the system of the boilers in this boat, making a cylindrical shell and a cylindrical flue through it; the shell 30 inches, and the flue 22 inches diameter, and 30 feet long. At the furnaces, it was 3 feet

6 inches diameter. A steam chest on each 5 feet high. These boilers worked at 60 lbs. on the square inch, and the steam was expanded and condensed. This boat was partly built to oppose a boat, built and fitted with engines in France, which had non-condensing engines, working at 75 lbs. pressure. She beat all our boats, but drew too much water for the summer time; however when our new boat started, she was full master of her, and finally ran her off the station. In 1837, I built another boat, 146 feet long and 11 feet 6 inches broad, with a 55 horse engine, working at 68 lbs. pressure and condensing, and she ran 48 leagues in 11½ hours.

One day, about this time, one of our men came and told me that there was a gentleman on board one of the boats, who could not speak French; so I went to see if he was an Englishman, and having spoken to him in English, he inquired for the builder of the light iron boats. On my telling him that I was the person, he informed me that he had been on the river Euphrates, and was then on his way home to England. That he had been talking to a person at the Hôtel de France, about the light boats which they had been trying on the Euphrates, and that with all their lightness, there was not enough water for them, and that the attempt was a failure. That he had inquired what draught of water they were, and on being told, said, "Oh, we have one of your countrymen here, who builds us far lighter boats than that, and I should recommend you to pay him a visit." Well, I showed him all in my power, one boat drawing 8 inches and another 9 inches of water, and I expected after this, that the East India Company would have had some boats built on the same system; but whether he reported on what he had seen, I do not know, but I never heard any more from him.

I fear I have wearied your readers with this egotistical narrative, but I am no writer, and you have the facts as I have them noted down. That I may not encroach too much on your space, I will leave the remainder of my yarn for your next number.

Your obedient servant,

A Practical Engineer.

For the Journal of the Franklin Institute.

On a Probable Means of Augmenting the Ascensive Power of Locomotives on the High Gradients of Railways. By Ellwood Morris, C. E.

It is well known that numerous accurate experiments on friction have established the law, that within the limits of abrasion, the friction is as the insistent weight, and not as the surface of contact.

These experiments, though they have formed the basis of many calculations of the various frictions of railways, and have been very valuable in this department of mechanical science in establishing *minimum* results, do not meet the practical acquirements of railway motions, because, in those motions invariably, when *maximum* effects are to be produced, the limit of abrasion is always reached and passed.

Of the friction of moving metals in contact, when abrading each other, we have no experiments whatever. Hence we have no means of calculating beforehand, the bite of a locomotive slipping her wheels upon a rail, because then both wheels and rails *abrade*.

We know that the maximum adhesion of engines upon dry rails, exceeds all results of calculation based upon the ordinary laws of friction, and hence some have been inclined to doubt the accuracy of those laws, though they are undoubtedly true, within the limits taken by the initial experiments upon which they were founded. When engines slip their wheels on railways, both wheels and rails abrade, the law of friction changes, and we enter at once upon a new field, in which we have no exact results recorded, and of which we only know that the coefficient of friction is greatly increased.

It is upon this meagre outline of facts, (which might be much extended if the authorities were at hand,) that the writer, from the observation of years in his professional avocations, has formed the opinion, that beyond the limits of abrasion, the law of friction, as applicable to brake blocks and the slip of wheels on rails, changes entirely, and that the bite or adhesion is in some degree proportionate to the surface of contact, as well as to the weight imposed. The writer believes this to be especially the case in the ascension of heavy gradients by locomotives, where the sand box is always used. In such cases, it is highly probable that a mere increase of the breadth of the rail, or surface gained, will augment very materially the bite or adhesion of the driving wheels, though the weight remains the same.

The usual surface of contact of wheel and rail, has a breadth of only *two* inches, while the wheels themselves have a breadth of nearly *four* inches. If then, beyond the limit of abrasion, the friction increases in the same ratio to the surface, (as the writer believes,) then upon high gradients, all we have to do is to lay down broad headed rails, conforming to the tire of the wheels, and thus increase at once the adhesion.

This, of course, supposes engineers to have surplus steam power; and such is usually the case with modern locomotives, which in fact, as now in practice, always do, or ought to, arrive at the foot of a steep grade with a full head of steam; then the sand box freely used upon a four inch rail, it seems highly probable, will augment so much the bite of the wheels, as to render high gradients less formidable than they now are.

To the above considerations, the writer respectfully invites the attention of his professional brethren, in the hope that some of the companies they serve may at once put this important matter to the test, and lay a few hundred yards of rails, four inches broad, upon the high gradients of some railway doing a heavy freight business. A few months' use, and a few correct experiments, would settle this question definitively, and the writer knows scarcely any other, of more moment to some railways.

On Railway Carrying Stock. By Mr. W. A. Adams, *of Birmingham.**

The object of the present paper is to discuss and analyse the various descriptions of Railway Carrying Stock, with the purpose of suggesting such improvements in the details of form and manufacture as will materially reduce the gross or dead weight of the vehicles, without affecting their efficiency or strength.

* From the London Artizan, for January, 1851.

This matter has been brought prominently under the writer's attention, from the fact, that upon leading lines of railway the first class carriages for the conveyance of 18 passengers have reached a gross weight of 5 tons, and wagons for the conveyance of a maximum load of 5 tons, have reached a gross weight of 4¾ tons. These, it is to be observed, are probably extreme cases, but being modern, they evidence the tendency to increase the weight of trailing stock.

It is scarcely needful to remark, that if a locomotive engine is capable of conveying a train of 50 wagons weighing 200 tons and the load 200 tons (which proportion will not be short of the truth, even without taking empties into account), a saving of one ton in the weight of each wagon will enable the engine to convey 50 tons additional of wagons and load, or equal to a saving of one-eighth in the cost of haulage.

In the important matter of inland through coal traffic, the wagon averaging 3 tons 15 cwt. carries 5 tons of coal. But as the wagon of course returns empty for 5 tons of coal conveyed one mile, 7 tons 10 cwt. of wagon has been conveyed the same distance.

In this instance the saving one ton weight in the construction of the wagon, would be equivalent to a total saving of nearly one-sixth in the cost of haulage; that is to say, if the present rates are remunerative, the prices may be reduced 16 per cent., inducing a much more extensive traffic, and better enabling railways to compete with water conveyance.

Inland coals are mostly conveyed in wagons belonging to the collieries, or rented to the collieries by private individuals. In either case, the tonnage or mileage charges on the railways being irrespective of the weight of the wagon, the object of the wagon owner is to produce such wagons as will be most durable with the smallest amount of first cost. The weights of colliery wagons have been gradually increasing, each new lot being made (as was recently observed by the manager of an extensive inland colliery) of such strength and weight, that in the event of a collision, they may break their neighbors, and remain uninjured themselves.

Engine and carriage superintendence are generally distinct departments. The carriage superintendent aims at the utmost economy of maintenance in his department, and produces carriages and wagons, which, though very lasting and very serviceable, are meanwhile greatly increasing the expenditure of the locomotive department. It would appear that in no case has the interest of the parties directly concerned been to decrease the weight of the vehicles.

The heavy trains handed over to the locomotive department to haul, induced the construction of more powerful and weightier engines, until the maximum was quickly reached, and checked by the sufferings of the permanent way.

It is to be observed, that the writer has no desire to carry the question of light vehicles to any Utopian extent, but simply to calmly study and elucidate, by experience and experiment, the practical means of reducing the weights of vehicles within proper bounds.

At the period of the commencement of railways, passengers were mostly conveyed by four-horse coaches, light goods by vans, and heavy goods by water. It is the intention of the writer of this paper to confine the inquiry to wheel vehicles.

The great distinction between road and railway vehicles is, that railway vehicles have to sustain longitudinal strains in the direction of the buffing, as well as lateral and perpendicular blows.

The four-horse coach weighing 19 cwt., conveyed 18 persons with luggage, weighing in all 1 ton 7 cwt., at a rate of 10 miles per hour.

The four-horse Brighton van, weighing 1 ton 11 cwt., conveyed 6 tons of goods at a rate of 4 miles per hour.

Every pound was carefully saved in weight of construction of the above vehicles. The timber was carefully selected English ash; not that ash was the most lasting and durable, but that for strength and toughness, it was unequalled in lightness, though short in its period of duration.

The axles and the iron-work were wholly made of the best marks of scrap iron. Skilled and costly labor of a high class was employed in the forging and fitting of the iron-work and the construction of the wood-work. In all cases where extreme strength was required, the timber was carefully plated with iron; obtaining the utmost strength with the smallest amount of material.

Builders competed, not so much in price, but as artists, to produce, by proportion of parts and materials, the utmost result with the least weight. The gradients were bad, the roads imperfect, the motive power limited. The wear and tear of the carriage was a secondary consideration to the cost of hauling power. The vehicles were probably as near perfection as man's ingenuity could produce them.

Simultaneous with the four-horse coach and van, was the conveyance of coals upon tramways with horse-power.

The writer will confine his observations to that district with which he is practically acquainted, that of Monmouthshire. The act for the making of the Sirhowy and the Monmouthshire tramways, a total length, exclusive of branches, of 26 miles from the mines and iron works to the shipping port of Newport, was obtained in the 42d of George 3d, and consequently 48 years since, and that tramway has been worked until within the last twelve months by horse power.

Originally it was a tramway with fish-bellied cast-iron plates laid and jointed upon stone blocks, with six feet bearings. These have gradually given place to rolled plates of malleable iron, weighing about 80 lbs. to the yard, and laid in chairs upon cross wood sleepers with 2 feet 8 inch bearings.

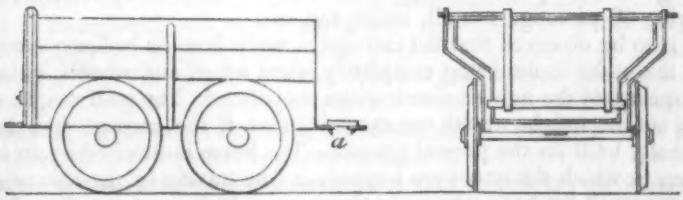

Fig. 1.

Fig. 1 represents the class of wagon, or as it is locally termed, *tram*, used upon this tramway. The gross weight was 16 cwt., and it carried 3

tons of coal at a rate of three miles per hour, exclusive of the time consumed at the various public houses by the tramway side.

The breaking or skidding down the inclines was effected in the most complete manner by means of a slipper or shoe, similar to that of a stage-coach, and the stopping of the train by thrusting a bar of wood through the spokes of the wheel, or, as it is locally termed, spragging the wheel. The unloading was effected by means of a gallows and crab, the tram being raised at one end, and the coals discharged by means of the swinging tail board at the other end.

It will be observed that no provision is made for buffing, but that the train is articulated by means of the hitching *a* shown in the drawing. The wheels ran loose upon the axles, and were in most instances dished in the manner of a common road wheel, thereby illustrating the first advance from a common road vehicle.

The tramway is mostly an incline from the mines to the port. Six horses brought down 60 tons of coals and 16 tons of trams. The same power was required to take up the empty trams. Dead weight in the trams was consequently of vital importance.

This tramway is now being worked with locomotive power and permanent wagons; the Tramway Company finding power, and the freighters wagons. The same care which influenced the private hauler, and caused him to equalize his upward to his downward load, does not now influence the freighter, and has been lost sight of by the company. In the eye of the freighter, the wagon which is strongest and heaviest is the best, and the consequence is, that wagons weighing three tons, are conveying but five tons of load.

The ratio of upward load was in the one case 21 per cent., and in the latter 37 per cent., as compared with the downward.

The weight of wagon conveyed up hill was in the one case 27 per cent., and in the latter 60 per cent., as compared with the coals brought down.

In place of a perfect horse tram-road, heavy engines are being hammered, and are hammering to pieces a bad road, with bad gradients and extremely bad curves. This is wholly true, but fortunately an extreme case; nevertheless, it is questionable whether many lines are not also suffering in a lesser degree from the incubus of dead weight.

The Huntingdon and St. Ives's branch of the East Anglian railway, $4\frac{3}{4}$ miles in length, is at the present time worked by a horse carriage. This carriage is a composite carriage consisting of three compartments, and carrying 60 passengers in all, inside and out.

It is to be observed that the carriage is made from an ordinary composite, the under frame being completely taken away, and wheels, guards, and springs of the lightest construction substituted. The total weight is 3 tons, but the weight would not exceed 2 tons, if the carriage had been originally built for the present purpose. The horse is attached by an outrigger, to which the traces are hooked, and he travels by the side of the carriage, with his head tied up to the carriage to prevent him from turning round. A break is applied to the wheels.

The writer has instanced this carriage to illustrate, that when horse power is brought into use, the weight of vehicle is at once considered; and also that the vehicle being used singly, does not require strength to

resist longitudinal buffing. The cost of working this carriage is six pence per mile, including horse and driver, and the guard, who is also ticket collector.

The pace is ten miles per hour, and it would appear that this application meets all the requirements of the limited traffic of a short branch.

Rapid strides were made by engineers in perfecting the way and the locomotive. The facts relative to the permanent way have been discussed and appreciated, and the details greatly perfected. Locomotives have been improved, the consumption of fuel brought probably nearly to the minimum; the details have been understood, discussed, and experimented upon by men of high talent and experience.

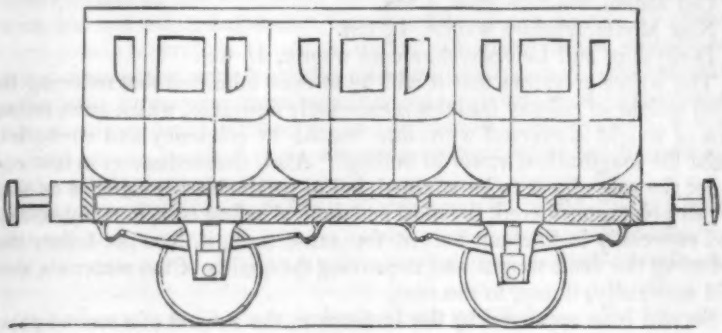

Fig. 2.

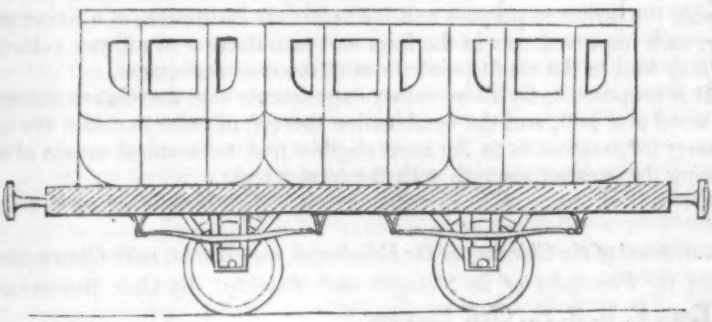

Fig 3.

But far differently with the matter of the carrying stock. The construction of the carriage and the wagon was in the commencement left wholly to men of long practice in carriage building for the common road, but not experienced in mechanical engineering.

Those patterns originally set, have been copied and re-copied in an almost servile manner. When carriages and wagons have failed in their parts, the sole remedy has been increase of strength by increasing the weight and quantity of material. Axles have increased from 3 inches diameter to 4 inches; tires from $4\frac{1}{2} \times 1\frac{1}{4}$ inches to $5 \times 1\frac{3}{4}$ inches, and so throughout.

Fig. 2 illustrates the original London and Birmingham, and Grand Junction first class carriages, with three compartments, carrying eighteen passengers.

Dead weight 3¼ tons.

Cubical contents 504 feet.

Fig. 3 illustrates the modern first class carriage, with 3 compartments, carrying 18 passengers.

Dead weight 5 tons.

Cubical contents 807 feet.

The dead weight of wagon, per ton of load, for the upward and downward journey of the—

Old Monmouthshire train, ½ ton.

New Monmouthshire wagon, 1⅓ ton.

Derbyshire and Leicestershire coal wagon, 1½ ton.

The writer presumes that it will be at once admitted that reducing the dead weight of railway vehicles is extremely desirable, whilst such reduction of weight is effected with due regard to efficiency and strength to resist the longitudinal strain in buffing. Also, that reduction in first cost is not the sole object to be attained, but to produce such vehicles as shall be, all points considered, the most economical in first cost, in maintenance, and especially in traction; but, at the same time, it does not follow that reducing the dead weight and improving the quality of the materials shall add materially, if any, to the cost.

Should it be approved by the Institution, the subject of a second paper will be to analyze and compare the whole of the modern trailing stock with that of an earlier period, and thereby glean such information as will enable the writer to prepare and lay before the Institution, in a future paper, such improvements in the form and manufacture of railway vehicles as may lead to the result pointed out at the commencement.

It is proposed to try all necessary experiments as to the relative strength of wood and iron, and the combination thereof, in order to obtain the necessary information as to the most eligible and economical means of attaining the greatest strength with the least weight.

An Account of the Chimney of the Edinburgh Gas Works, with Observations on the Principles of its Strength and Stability. By Geo. Buchanan, Esq., F. R. S. E., *Civil Engineer.**

(Paper read at the Royal Scottish Society of Arts.)

In this paper, Mr. Buchanan concluded with some observations on the effects of the draft in the chimney, a subject of great importance in regard to chimnies generally for large furnaces, where enormous quantities of air are continually passing in the act of combustion. This had been estimated by the eminent chemist, Professor Thomson, of Glasgow, at 150 cubic feet per minute for every pound of coal consumed, and 50 more for waste—in all 200. Hence in the boilers of many steam-vessels, for example, consuming one ton per hour, 7400 cubic feet of air per minute must pass up their narrow funnels, and being limited also in height, must be raised to a high temperature, and this, as at present constructed, by

* From the London Architect, for December, 1850.

a great sacrifice of fuel. In the Gas Works, the 68 furnaces consume 34 tons in 24 hours, requiring a current of air at the rate of 10,000 feet per minute, which the old chimnies were incapable of drawing. Mr. Buchanan then stated the principles on which the power of draft must be calculated, referring to the article *Furnace* in the Encyclopædia Britannica, last edition, where he had occasion to explain the subject. The power of the draft was directly proportional to the height of the chimney, and the velocity with which the external air rushes in to supply the draft was proportional to the *square root* of the height of the chimney. The internal heat, however, was the grand moving power, expanding the air within the chimney, and giving it a buoyant or ascensional power. With 488 degrees of temperature, the celebrated chemists, Petit and Dalong, and most accurate observers, had found that air expands into double its volume. With this temperature, therefore, within the chimney, the velocity with which the external air was capable of entering at the bottom of the chimney, or into the furnaces or flues, would be proportional to the square root of half the height of the chimney, and expressed numerically in feet per second, would be equal to six times the square root of half the height, or $V=6\sqrt{\frac{H}{2}}$, V being the velocity in feet per second, and H the height of the chimney. This forms an easy rule for this particular temperature, and if we apply to it in the present case, taking the height of the chimney from the entrance flue at 330 feet, would give a velocity of about 50 feet per second, or 34 miles an hour, equal in the atmosphere to a very violent gale of wind. Taking the smallest area of the chimney, where it is 11 feet 4 in. in diameter, at 100 square feet, this with such a power of draft would be capable of discharging 30,000 cubic feet per minute, which is amply sufficient for the present works and any extensions. The actual results have proved very satisfactory. Not only is there a draft in the furnaces, whereby they are wrought most effectually and with great economy of fuel, but by making one or more openings at the bottom of the chimney, a powerful blast of air sets in from all directions, carrying off vapors and all impurities, and producing a cool atmosphere in every part. On measuring the power of draft with a water pressure gauge, he found it drew up a column $3\frac{1}{2}$ inches high, there being a good deal of wind at the time. The blast of air at the mouth of the opening, it is curious to observe, drawing the hand powerfully in, and a square board covering the opening it was difficult to withdraw, exerting a pressure of 15 lbs. on the square foot. High winds have a sensible effect on the draft, sometimes raising the water gauge to a height of 6 or 7 inches. A pressure of $2\frac{1}{2}$ inches, which it would be in calm weather, is very nearly equal to a column of air half the height of the chimney, and this agrees very well with the above calculation, as the interior temperature would not exceed 480 or 500 degrees. As a general rule for calculating the power of the draft at any temperature, the following would be found simple and agreeable to the practical results: $V=6\sqrt{\frac{nH}{488+n}}$, n being the number of degrees of temperature.

Mr. Buchanan then gave a detail of the experiments formerly alluded

to, made upon the strength of the bricks for the chimney in 14 specimens of different qualities and compositions. By far the strongest was the composition of fire-clay and iron-stone, which bore, making every allowance, from 200 to 350 tons on the square foot; while the common quality did not exceed from 60 to 120 tons. The Hailes stone bore upwards of 450 tons, greatly more than the result found by the experiments already shown to the Society, but which, being on small specimens, 1 inch cube, while the other was 4 inches cube, the effect might partly be due to this circumstance, together with the difference of quality in the specimens.

A Detailed Description of the above Chimney. By M. Taylor, Esq., *Engineer for the Edinburgh Gas Works.*

In this paper Mr. Taylor gave a minute detail of the dimensions and structure of every part of the work. The foundation was on hard shale or clay; the masonry 40 feet 6 inches square at the bottom, 12 feet below the surface of the ground; 32 feet 6 inches at the surface of the ground; and brought up by steps in hard foundation courses of Craigleith stone, dressed and square jointed. Mason-work of the most substantial description, with four eyes for connecting the main flues to the stalk. Square pedestal 65 feet high from surface of ground to top of base of brick shaft; 30 feet 10 inches square at base course; 30 feet square above base, and 27 feet 9 inches under moulding of top. Body of pedestal of neatly covered rubble-work of the strongest kind, the stones chiefly from Hailes Quarry of the best rock. The cope mouldings and base of brick shaft of Craigleith. Within the pedestal, and rising 20 feet above it, is an inner chimney or brick shaft standing quite detached, having a space from 18 inches to 2 feet clear in every part; this space covered over at the top to keep out soot deposit, but yet left free of the outer pedestal and chimney. The inner chimney is 90 feet high, 13 feet diameter inside, carried up at four different thicknesses, beginning at 3½ bricks thick, and ending at 2 bricks, including a lining of fire-brick, carried up the whole way at two thicknesses—20 feet at 10 inches thick, and 70 feet at 5 inches. The brick work of the best well-burnt circular stock-brick, with a course of headers in reeled order for every four courses of stretchers. The main brick shaft is 264 feet high above the stone pedestal; making, with the pedestal, 65 feet, and foundation 12 feet 6 inches—in all, 341 feet 6 inches. The shaft is 26 feet 3 inches diameter at bottom externally, tapers to 13 feet 10 inches at the height of 243 feet, at the first belt under coping 11 feet 10 inches below the top. The shaft is carried up at five different thicknesses, beginning at 35 inches, or 3½ bricks, for 35 feet up, and ending with 15 inches, or 1½ bricks, for 58 feet at the top, all built with hard circular composition brick, referred to in the experiments on the strength of bricks. Brick-work put together in the strongest manner with headers, as already described, and best band all laid in the best lime from Burdiehouse, with sharp sand, sifted and made up in the mill. The beds are kept as thin as possible, and neatly pointed-in with the edge of the trowel. All the vertical joints inside of wall, grouted up with thin lime. As a farther security, the shaft is bound with six malleable iron hoops, at intervals of

35 feet up, built into the brick-work, one brick on bed from the outside, and kept a half inch clear all round off the outside lining of brick-work, so as to allow the hoops to expand with heat without injury to the work. They are all 3 inches broad; the under three 1 inch thick, the upper $\frac{3}{4}$-inch each, made in three lengths, clamped together and made fast with three $\frac{7}{8}$-inch or $\frac{3}{4}$-inch rivets on each side. The projecting cope at the top is of cast iron, 19 feet 6 inches diameter over all, and in sixteen pieces about $\frac{7}{8}$-inch thick, screwed together with bolts through the flanches. This cope being all fitted and bound together in a mass on the top of the stalk, the brick-work was continued up, and finished with a cope, or plate of cast iron, composed of eight pieces $\frac{3}{4}$-inch thick, and about $2\frac{1}{2}$ feet broad, with a round belt going 9 inches down on the brick-work, and forming a strong hoop round it. The chimney is furnished with an endless chain going up the inside of the main shaft, giving the means of ascending at any time to the top. The electric conductor stands 6 feet above the top plate, $\frac{5}{8}$-inch round copper made fast to stone and brick-work, with $7\frac{7}{8}$ in. copper holdfasts let 4 inches into the masonry or brick-work, with a head on the inside and an eye on the outside to receive the rod as it was carried up. By these holdfasts an ascent can easily be made to the top by a small tackle suspended to the holdfasts. The conductor is metallically connected to all the iron-work on the stalk—the plate on the top, projecting cope, malleable-iron hoops, bolts on the top of the stone pedestal, and also the ascending chain. The rod descends into a well about 10 feet from the foundation, and is immersed about 8 feet deep in water, and the end turned up 2 feet in a horizontal direction, and flattened.

Extract from the Annual Report of the Board of Canal Commissioners of the Commonwealth of Pennsylvania, for the year ending Nov. 30, 1850.

The gross receipts on all the lines of canal and railroad belonging to the Commonwealth, for the year ending the 30th of November, 1850, amounted to $1,768,209·46, and the expenditures for ordinary repairs and breaches, including the cost of the temporary means of maintaining the passage for boats across the Susquehanna river at Clark's ferry, to $857,228, showing an excess of receipts over expenditures of the sum of $910,981·46. The net receipts of 1850 exceed those of 1849 by $36,204·61.

The past fiscal year has been remarkable for the number of high freshets with which the several lines of canal yielding the largest portion of revenue have been visited. A succession of breaches occurred from the high waters in July, August, and September, by which the navigation of the main line, at its eastern terminus, and of the Susquehanna, West Branch, North Branch, and Delaware Divisions, was materially impeded by the time necessarily occupied in making extensive repairs.

To add to these calamities, on the morning of the 11th September the towing path and road bridge over the Susquehanna river, at Clark's ferry, was fired by an incendiary, and the superstructure totally destroyed, thus rendering it incumbent on the Board to fit up, at a heavy expense, a steam towing boat, for the purpose of maintaining, as far as practicable, the speedy transit of boats at that point. These combined causes, as a

matter of course, affected the revenues to a considerable extent, and added largely to the expenditures. The cost of repairs by floods, and the fitting up the steamboat, irrespective of the loss of the superstructure of the bridge at Clark's ferry, amounted to $66,573·44.

The following statement exhibits a more detailed account of the receipts and expenditures than is contained in the foregoing abstract:

RECEIPTS FOR ALL PURPOSES.

Columbia Railroad.		
Philadelphia,	$359,647·18	
Paoli,	21,660·49	
Parkesburg,	29,189·84	
Lancaster,	66,985·74	
Columbia,	160,657·31	
Schuylkill viaduct,	307·00	
Total Columbia Railroad,		$638,447.56
Allegheny Portage Railroad.		
Hollidaysburg,	$145,500·57	
Johnstown,	96,316·88	
Total Portage Railroad,		241,817·45
Main Line of Canal.		
Columbia, including outlet lock,	$147,265·05	
Portsmouth,	14,619·75	
Harrisburg,	29,373·49	
Newport,	4,407·70	
Lewistown,	13,829·09	
Huntingdon,	14,284·23	
Hollidaysburg,	36,205·92	
Johnstown,	60,772·73	
Blairsville,	6,491·58	
Freeport,	3,154·29	
Pittsburg,	146,137·08	
Portsmouth outlet lock,	1,182·75	
Swatara bridge,	275·00	
Duncan's Island bridge,	1,181·66	
Juniata aqueduct,	89·07	
Freeport aqueduct,	177·00	
Total Main Line Canal,		479,446·39
Delaware Division.		
Easton,	$173,650·09	
New Hope,	15,079·21	
" outlet lock,	3,786·00	
Bristol,	22,832·57	
Total Delaware Division,		215,347·87
Susquehanna, North and West Branch.		
Dunnsburg,	$18,361·03	
Williamsport,	16,787·04	
Northumberland,	39,878·93	
Berwick,	102,228·33	
Liverpool,	15,894·86	
Total Susquehanna, North and West Branch Divisions,		193,150·19
Total gross receipts on all the lines,		$1,768,209·46

EXPENDITURES.

For maintaining motive power on the Philadelphia and Columbia Railroad, including repairs and management of trucks, and purchase of one locomotive engine from motive power fund,	$201,810·83	
For the purchase of three new engines from special appropriation per Act of 10th April, 1849,	24,600·00	
For repairs of Philadelphia and Columbia Railroad,	71,466·39	
For collectors, weigh-masters, inspectors, and incidental expenses of their offices,	12,466·98	
		$310,344·20
For maintaining motive power on the Allegheny Portage Railroad, including the repairs and management of State trucks, the purchase of passenger cars, and two new locomotive engines,	$182,941·24	
For ordinary repairs on Allegheny Portage Railroad,	43,330·03	
For extraordinary repairs of inclined planes, per Act of 10th May, 1850,	18,579·94	
For collectors, weigh-masters, inspectors, &c.,	2,992·96	
		247,844·17
For ordinary repairs on main line of canal,	$101,242·18	
For breaches on main line,	16,856·53	
For collectors, weigh-masters, inspectors, &c.,	16,553·06	
For lock tenders,	27,249·00	
		161,900·17
For repairs on Delaware Division,	$32,066·85	
For breaches on "	19,182·55	
For collectors, weigh-masters, inspectors, &c.,	4,059·82	
For lock keepers,	5,525·00	
		60,834·22
For repairs on Susquehanna Division,	$9,182·00	
For breaches on "	4,000·00	
For repairs on West Branch Division,	12,548·72	
For breaches on "	12,778·67	
For repairs on North Branch Division,	12,000·00	
For breaches on "	13,755·69	
For collectors, weigh-masters, inspectors, &c.,	6,150·56	
For lock keepers,	5,889·00	
		76,304·64
Total expenses,		$857,228·00
Gross receipts,		1,768,209·46
Net receipts over expenses,		$910,981·46

Adding to the expenditures the pay of the Canal Commissioners, secretary, messenger, and the incidental expenses of their office, amounting to $5300, the actual net receipts for the year 1850 are $905,681·46, being an increase over the net receipts for 1849, of $30,904·61.

The officers have been specially instructed to include in their reports the entire cost of repairs, whether paid or unpaid, so as to present to the Legislature a correct statement of the actual cost of the public works for each financial year. It is believed that this direction has been faithfully observed. These reports form the basis of the preceding abstract, from which it will be seen that the expenditures for all purposes, exclusive of farm bridges, amounted to $862,528. In this statement, however, is included the extraordinary repairs to the inclined planes on the Allegheny Portage Railroad, the purchase of six new locomotive engines, and the sum of $66,573·44, for repair of damages by floods and fire.

The report of the Superintendent of motive power, and Supervisor of repairs on the Philadelphia and Columbia road, exhibits a very comprehensive view of the condition and operation of that part of the improvements. His report on the motive power departments presents the following statement:

The number of cars passed over the road in 1850, amounted to 140,394, exceeding the number passed in 1849, by 19,562.

The freight passed over the road amounted to 265,113 tons, being an increase over the last year of 45,632 tons.

The number of miles traveled by passengers was 8,060,278, equal to 98,296 through passengers, being an excess of through passengers over 1849, of 8646.

The number of trips run by locomotives was 8074, or 630,084 miles, being an increase of 604 trips, or 47,112 miles over the preceding year.

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*General Rules for Proportioning the Length of Boilers for Stationary Engines.**

Rule 1.—A plain cylindrical boiler, without any inside flue tube, and hung on what is sometimes called the "oven plan," that is, with a direct draft passing from the fire-place directly under the bottom of the boiler to the vent or chimney, and without return flues of any kind, need not exceed in length *six* times its diameter; and it ought not to exceed *six* times the square root of the area of the fire grate in feet if worked with Lancashire, Derbyshire, or Yorkshire coal, which is equivalent to *six* times the square root of the nominal horse power of the engine in feet. And if worked with the best Newcastle coal, the boiler need not be more than about eight diameters long, and ought not to exceed eight times the square root of the area of the fire grate in feet, which is equivalent to eight times the square root of three-fourths of the nominal horse power of the engine in feet; and in any case it never ought to exceed *six* feet in diameter.

Rule 2.—A boiler without any inside flue tube, and set up in the common way, with external brick flues and a wheel draft, need not be more than about *four* diameters long, and ought not to exceed in length four times the square root of the area of the fire grate in feet for Lancashire coal. If worked with Newcastle coal, it ought not to be more than about five diameters long, and need not exceed in length five times the square root of the area of the fire grate in feet; and in either case, whether a wagon or cylindrical boiler, it never ought to be more than six, nor less than four feet in diameter.

Rule 3.—If a boiler contains one or more inside flue tubes, passing quite through it, and is to be set up with a split draft, it need not be more than about three and a half diameters long, and ought not to be longer than three and a half times the square root of the area of the fire grate in feet for Lancashire coal; and if worked with Newcastle coal, it need not be more than about four and a half diameters long, and ought not to exceed

*From the London Artizan, for January, 1851.

four and a half times the square root of the area of the fire grate in feet; and never be less than five feet in diameter.

Rule 4.—When a boiler contains one or more internal flue tubes, with an inside uptake or connexion with the boiler bottom, as in Boulton and Watt's, or as in the marine "tubular," and other multiflue boilers, the length of the boiler need not be more than about *three* times its diameter with Lancashire coal, and ought not to exceed in length three times the square root of the area of the fire grate in feet; but with Newcastle coal its length in feet may be equal to four times the square root of the area of the grate, and need not be more than about four times the diameter of the boiler.

Rule 5.—Cornish boilers and Butterly boilers, set up in the best manner, with split draft, and using Lancashire coal, need not be more than about three and a half and four diameters long respectively; and if using the best coal, they ought not to be more than five and a half and six diameters long.

Boilers whose dimensions are proportioned within the limits stated in the above practical rules, more especially those indicated by the three last, are mostly the best to be found of each kind in the manufacturing and midland counties.

The manner of hanging boilers, to which the first rule relates, is yet generally confined to some country places where inferior workmanship only can easily be obtained, and where the space occupied by the greater length of the boiler is not of much value; consequently the data for this rule have not perhaps been quite so exactly determined as may be. There are reasons for supposing that the direct draft cylinder boiler may be made considerably shorter than the proportion of six to one, as stated in Rule 1, if the fire could be equally well arranged as in the wagon boiler, the concave bottom of which is admirably adapted to this purpose, because the middle of the grate, where the heat is the most intense, is at the greatest distance below the boiler bottom, while the latter gradually approaches nearer to the grate at the sides of the furnace, and thus tends to equalize the action of the fire against the boiler. The bottom of the cylindrical boiler being convex downwards, the action of the fire is of course exactly the reverse of the above. To say nothing of the injury done to the boiler plates on this account, there requires to be a greater average distance between the grate and the boiler bottom; this, again, requires a greater quantity of coal in the furnace, which impedes the draft, and renders stoking necessary, thus causing the flame to be occasionally extended in length; and although such undue length of flame cannot be kept up continuously with any degree of economy, it has given rise to a natural, though unfounded, prejudice against this mode of setting a boiler, often expressed in the observation that "*all the heat goes up the chimney.*" Erroneous as the idea is that gives rise to this very common remark, it is not a little strengthened by the fact that the temperature of the chimney is always very much greater with a direct draft than it is where winding brick flues are used, which may be considered only as a portion of the chimney lying horizontally, the superfluous heat in which is doing no good, and is really "waste heat," from the great inconvenience and trouble it occasions; whereas, when this waste heat is allowed to go freely

up the vertical shaft of the chimney, it really becomes of great use in increasing the ascensional force of the current; thus improving the draft, and enabling the boiler to be worked generally with the damper nearly closed, as all steam engine boilers ought to be worked.

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*Boilers on the Oven Plan Liable to Explosion from Surcharged Steam.**

When a boiler is set up or "hung" with a direct draft, as described in Rule 1, it is very commonly, but erroneously, said to be on the "*oven plan*," which designation ought to be confined to those only where the flame is caused to pass wholly or partially over the top of the boiler, although they have generally a direct draft also. The use of such plans, however, cannot be too much reprehended as pregnant with danger, from surcharging the steam with heat, and thereby becoming liable to explosion. Few, however, if any, are now set up in that way; but I cannot help thinking that some of the otherwise unaccounted for explosions which have occurred of late years have been owing to a similar cause.

Now, supposing this over-heating of the steam and the top of the boiler to occur from either of the above causes, while the engine is at work, it is not perhaps likely that anything particular will be observed to ensue, unless, probably, the burning of the clothing or other covering of the boiler. But let us examine the matter when the engine has been standing for some time, *or when just about to start after the first getting up of the steam*, and we shall find a very different state of things, the consequences of which, if only leading to the slightest probability of resulting in an explosion, are too serious to be passed over without great consideration.

We may suppose, then, that the steam chamber has become filled with over-heated or surcharged steam from any cause whatever, whilst the top of the boiler is also in the condition already described, that is, exposed to a temperature of, say from 350° to 400°; which supposition is quite consistent with the fact that the great bulk of the water in the boiler may be at the same time considerably below the common boiling point. And although this last assumed fact is, perhaps, only of rare occurrence in boilers which have their fires underneath them, it cannot be too widely known, that in all stationary boilers which have internal furnaces, it is not only of frequent occurrence, but it is a common observation of most practical engineers and workmen, that at the first getting up of the steam from cold water in a boiler of this description, with the safety valve and all other outlets of the boiler closed, the *water at the lower part of the boiler is often quite cold*, whilst there is a pressure in the boiler of 10 or 20 lbs. on the square inch.

As my object in thus tracing the proximate causes concerned in producing the dangerous consequences that may ensue, is for the purpose of suggesting the means of prevention, it will be here useful to observe, that whatever may be the pressure of the steam due to the actual evaporation at this stage of the process, it will be nearly doubled by the heat of the steam chamber, supposing the latter to have arrived at about 400°,

*From the London Artizan, for January, 1851.

which is still under the temperature that would leave any permanent traces of its existence on the metal, the lowest temperature that gives the first discoloration to iron (a straw color) being about 430°. Now, excepting by the thermometer, there is only one other means of giving the fireman any ready indication or suspicion of there being any thing wrong about the boiler; and rough and uncertain as that indication is, it is always sufficient to create alarm, and induce him to take some instant precautionary step; and whether that step be properly or improperly taken, will make all the difference between hastening and preventing the catastrophe of blowing up the boiler. The indication I am alluding to may be thus described:—whenever a fireman finds that, on getting up the steam previous to starting an engine, more particularly after a boiler has been at rest, and refilled with cold water, that the pressure rises to a certain height *in about half the time* that has usually been the case previously; or if, after firing a certain time, and consulting his steam gauge, he finds that the steam has run up to 10 or 20 lbs. pressure, instead of 5 or 10 lbs., as he expected, in the same time, and if the man has been accustomed to the same boiler, and is assured there are no unusual circumstances, of draft or otherwise, to account for the difference, then he may be almost certain that there is surcharged steam in the boiler.

Now, an idle or a careless stoker might not perhaps notice the circumstance just described, so long as the required pressure is not reached, which the safety valve is loaded to blow off at; which is the case no doubt very frequently, and the circumstance is thus passed over without danger, or the suspicion of danger. But what is the step that a *careful*, and still more, a *timid*, man would be likely to take at such a time? In all probability, if the means were at hand, he would either "feel" or lift the safety valve; and what is the consequence that would be most likely to follow? In the case we have supposed, it certainly would not be safety, but danger, and very possibly immediate destruction; for when a safety valve of any considerable area is thrown *suddenly* wide open, there is always a sudden rush of water, or rather water and steam mixed, to the opening. This is well known to occur universally under such circumstances, and I have more than once seen it purposely exhibited by foolhardy engineers, by way of *illustrating* the nature of priming, as *priming* in fact it is, at the safety valve instead of into the cylinder.

We need not, however, suppose that this is exactly the course taken in the case under consideration; for a *very* careful man would perhaps only ease the safety valve gently on its seat; and if it was in a cotton mill or other factory requiring to be heated by steam, the almost certain course he would take would be to let the steam into the pipes for that purpose; and whether he opens the communication suddenly or slowly, the effect produced is, that the surface of the water is simultaneously relieved from a portion of the pressure, and in consequence of being so relieved, the water immediately commences boiling, not so violently perhaps on the instant, but sufficiently so to change it from its hitherto quiescent condition to a state of active circulation at least, if not of actual ebullition at the surface. Now this, or *any other disturbance of the surface* of the water, starting the engine for instance, will rapidly supply the surcharged steam with its full complement of water, that being all that is wanted to cause

the pressure to mount up suddenly from 20 to 200 or 300 lbs., perhaps in a few seconds, or to such pressure as is due to the final temperature of the steam when fully saturated with water, the *dry* surcharge or *desiccated* steam, as it may be called, suddenly becoming ordinary steam of somewhat less temperature, but enormously increased in density and pressure, with what effect on the boiler of course depends entirely upon the strain it is capable of bearing without rupture.

Supposing the iron to have arrived at about 400° Fahr., full saturated steam in contact with it will assume a pressure of about 215 lbs. per square inch above the atmosphere, a pressure quite equal to account for many of the disastrous explosions we have on record.

For the Journal of the Franklin Institute.

Notes on the U. S. War Steamer "Spitfire." By Chief Engineer B. F. Isherwood, U. S. N.

The "Spitfire" was originally built for the Mexican government, but at the commencement of our late war with Mexico she was still in the hands of the builders, from whom she was purchased by the United States and sent upon the Mexican Gulf coast, where she was exceedingly serviceable in expeditions against the interior; her small size and light draft of water allowing her to cross the bars and ascend the rivers, while her battery was sufficiently heavy to be very effective in the bombardment of the towns. Throughout the whole war she proved a very useful and efficient war steamer for the peculiar river and town warfare she was engaged in. A brief record of her dimensions, power, speed, &c., will be valuable, as it is only such class steamers that can be rendered truly available either for attack or defence on the Mexican Gulf coast, or the southern United States coast. Our large war steam frigates, the "Mississippi" and "Princeton," which were also on the coast of Mexico during the war, though invaluable for towing and dispatch vessels, were useless as war steamers from their great draft of water, viz: 19 feet, which prevented them from ever approaching the sandy shores of the Gulf; and as the Mexicans possessed no marine, our large ships of war were completely useless from the want of objects on which to use their batteries.

Hull.—The "Spitfire" was 118 feet long on deck, 22½ feet extreme beam, 9½ feet depth of hold, and 241 tons burthen. Mean draft of water, 7¾ feet.

Battery.—One eight inch gun, (68-pounder,) mounted forward on a pivot, and two 32-pounder broadside guns aft.

Engine.—One half beam engine (Lighthall's patent,) cylinder lying horizontally over the keelson. Diameter of cylinder 36 inches, stroke of piston 6 feet. The main cranks, however, were only 2½ feet between centres, the connecting rod being attached nearer to the centre of motion of the beam than the piston rod. The engine had a piston valve 18 inches diameter, packed by rings set out with screws. This valve was of the length of the cylinder, and had no lap. The steam was worked expansively by a separate slide cut-off, situated on the opposite side of the cylinder, and cutting off at a little beyond half stroke. The capacity of

the steam space between the cut-off valve and the steam ports of the cylinder was *one-seventh* the capacity of the cylinder. The loss of effect from this cause was considerable: had the steam been cut off at the nozzles of the cylinder at half stroke, the labor performed by the steam after expansion could be represented by 0·69, the labor performed before expansion being taken as 1·00; if the steam, however, be now cut off at such a distance from the nozzle as to leave one-seventh the space displacement of the piston between the cut-off and nozzle, the cut-off valve closing at the same point as before, the labor performed after expansion will be represented by 0·81; the labor performed before expansion being taken as 1·00. But the quantities of steam expended in the two cases will be as 1·00 to 1·29, while the effects are only as 1·69 to 1·81, or as 1·00 to 1·07. This must be kept in view in considering the consumption of fuel, as a better arrangement of valves would have given equal power with the same initial pressure of steam, and a much less consumption of fuel.

Boilers.—The vessel was provided with two iron boilers, placed one on each side of the engine. They were of the double return drop flue kind, the flues being 12 inches in diameter. Total amount of heating surface, 750 square feet:—of fire grate surface, 47 square feet. Aggregate areas of the cross sections of the flues, or *calorimeter*, 6·29 square feet. From these figures it will be seen that the proportion of fire grate to heating surface was 1 to 16; of calorimeter to fire grate, as 1·00 to 7·47. The boilers were flat bottom and sides, with a semi-circular top; the shell was stayed at every 12 inches, and would bear a working pressure of 20 lbs. per square inch, which was frequently carried when towing. The mean pressure carried at sea was 12 lbs. per square inch, the piston making 27 strokes per minute, cutting off a little beyond half stroke. The boilers would supply the cylinder for this number of strokes and steam pressure with great ease, maintaining the density of the water at $\frac{1·75}{32}$, (that of sea water being $\frac{1}{32}$,) at which density, and the temperature normal to 12 lbs. of steam above the atmosphere, there was never made any scale, though steaming constantly among the coral reefs of the Gulf of Mexico. The boilers had so great a capacity of steam room (they had no steam chimney) that they never foamed or primed. The hourly consumption of fuel was 658 lbs. of bituminous (Cumberland) coal, or 14 lbs. per square foot of grate per hour. From this data the boilers evaporated 4·14 lbs. of sea water per hour per pound of coal. Estimating the loss of heat by "blowing off" at 15 per cent., the boiler evaporated 4·87 lbs. of sea water per pound of coal. This low evaporative efficiency of the boiler, economically considered, might have been anticipated from the small proportion of heating to grate surface, and from the quantity of coal consumed per hour on each square foot of grate considered in connexion with the calorimeter, which was only 1 to 7·47 of grate surface, instead of 1 to about 5·2 of grate surface, which would have been about the proper area to supply the amount of fuel burnt, with sufficient oxygen to evolve all the caloric it was capable of giving out.

Paddle Wheels.—The paddle wheels were of the common radial kind, 18½ feet from outside to outside of paddles. Length of paddle 6½ feet; breadth, 22 inches. Each paddle in two pieces, 12 and 10 inches,

bolted on opposite sides of arm. Mean immersion of lower edge of paddle 40 inches.

The bunkers carried about 80 tons of coal, which was stowed principally forward of the engine and boilers, extending entirely athwart the vessel. With the bunkers full, the vessel was a little by the head; but when, by the consumption of the coal, the bow was so far lightened that the vessel was about a foot by the stern, which was the case when the bunker was about half exhausted, the vessel's speed would increase nearly a mile an hour with the same boiler pressure.

The "Spitfire" had a sister vessel, the "Vixen," built from the same lines, of exactly the same size of hull, engine, wheels, &c., and carrying the same armament, crew, &c.; but with equal boiler pressure, the speed of the "Spitfire" exceeded that of the "Vixen" by about $\frac{3}{8}$ths of a mile per hour.

During the bombardment of Vera Cruz and other towns, where the "Spitfire" was engaged, her three guns were run out on one side, and fired in broadside together as rapidly as they could be loaded, the guns being frequently double shotted; yet, notwithstanding the great disproportion between the size of the battery and vessel, and the light scantling of the latter, the vessel did not sensibly feel the recoil.

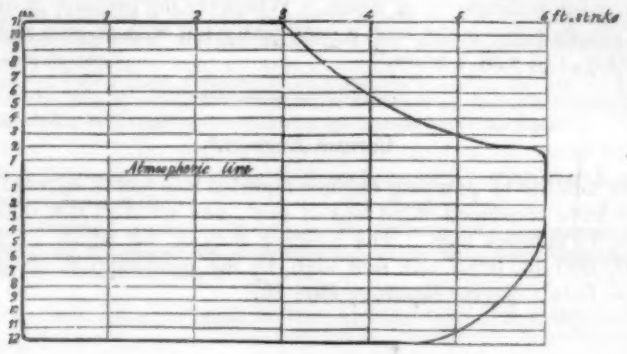
The "Spitfire" was a two masted, fore and aft rigged vessel, the foremast also carrying a large square sail; and although the proportion of sail to hull was as great as in sailing vessels, yet she was entirely inefficient under canvass alone, making, when light, (all coal out of bunkers,) with a good working breeze abeam and smooth sea, only three knots per hour, and even then, her leeway equalled her headway. Nor was her sail of any value as auxiliary to the steam, except with a fresh breeze abaft the beam, and even then it gave but a very slight increase of speed; with the wind abeam, or forward the beam, the sail was a disadvantage. She would have been a much more efficient war vessel for the peculiar localities she was engaged in, had her masts been taken out on her arrival on the coast. Her draft of water could have been lightened 8 inches by the omission of the spars, unnecessary anchors, cables, &c., with which she was loaded. In the latter particulars, she was provided like a second class sloop of war, although a steamer acting principally in rivers, and always in sight of the shore.

As much has been said about the difficulty encountered with single engines in "getting on the centre" when working slowly in a heavy head sea, I will take occasion to say, that the "Spitfire" was in some of the most violent "Northers" that blow during the winter in the Gulf, and laid to in the heaviest head seas I have ever witnessed, and I have crossed the Atlantic several times. While thus laying to, her engine would make from 4 to 6 revolutions per minute, with great regularity, never stopping or hesitating on the centre. It is, indeed, impossible to keep an engine on the centre in a sea way for a single instant, without first blocking the machinery, for the action of the waves on the wheels keeps them constantly moving. When we were anchored behind the reefs that form the anchorage of Anton Lizardo, during some violent gales, the light swell raised by the wind on the leeward side of the reef, would keep the engine con-

stantly turning when the grease cups in the cylinder were opened to permit the escape of air.

PERFORMANCE.—The mean pressure of steam carried in the boilers above the atmosphere was 12 pounds per square inch. Number of strokes of the piston per minute, 27. Expansion valve closing a little beyond half stroke. Speed of vessel, 7·36 statute miles per hour. This was for the ordinary condition of water and weather found at sea. Slip of the centre of reaction of the paddles, 13·34 per cent. Loss by the oblique action of the paddles on the water, 18·5 per cent. Power required to work the engine, overcome load on air pump, friction of the load, &c., (obtained by estimating the initial pressure in the cylinder at 1 lb. less than the boiler pressure, and the back pressure at 3½ lbs.; considering the friction of the working parts of the engine at 5·5 per cent., the power to overcome the load on the air pump at 1 lb. on the steam piston, and the friction of the load at 10 per cent.,) 20·71 per cent. Leaving to be applied to the propulsion of the vessel 52·55 per cent. of the total power developed by the engine.

The subjoined indicator diagram was taken under the above mean conditions:—



Steam per boiler gauge above atmosphere, 12 lbs. per square inch.
Strokes of piston per minute, 27.
Mean effective pressure throughout stroke, 19·2 lbs. per square inch.
Area of steam port, 100 square inches.
Space displacement of piston per stroke, 42·408 cubic feet.

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*On the Adhesion of the Safety Valves of Steam Boilers.**

The following important fact, with respect to steam boiler safety valves, transpired at the inquest on those killed lately by a boiler explosion at Halifax, Yorkshire:—The galvanic adhesion arising from the combination of iron and brass in the seat and disk of the safety valve, is not generally

* From the London Mining Journal, No. 800.

known, and is too important to be overlooked by engineers, and those entrusted with the charge of steam boilers:—Mr. Wilson, engineer, said he had "examined the safety valve, and the result of my examination is to find that the seat is of cast iron, and the valve is of brass, which, in my opinion, renders the action of the same quite uncertain at any pressure. This has been explained on the principle that steam acting upon these two metals produces what is called galvanic adhesion; a particular instance of which I have noticed from my own experience, where the valve had been working freely, and in the course of a very short time I had to use a hammer to remove it from its seat; when afterwards relieved, I had enough to do to hold it down by a lever at least four to one. The working pressure of the valve I am referring to was 50 lbs., which, upon calculation, from the pressure required to hold down the lever, could not be less than double that amount. In this case, the uncertainty of the action of the valve, with the pressure gauge in the state just explained, may account for a pressure beyond calculation at the time of the explosion. * * * I have no proof in this instance that galvanic action had taken place. The valve seems to have been free, but it is possible it may have occurred, and in my opinion it is a very probable case. This result is likely to happen in a valve only recently made. It depends upon a given quantity of heat and a given temperature of steam. Whenever the pressure is overcome with a brass valve in the seat, it rises gently; but with an iron seat it rises suddenly, and with a noise."

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*Cornish Engines.**

The number of pumping engines reported this month is twenty-seven. They have consumed 2323 tons of coal, and lifted 21,000,000 tons of water, 10 fathoms high. The average duty of the whole is, therefore, 52,000,000 lbs. lifted one foot high, by the consumption of 94 lbs. of coal.—*Lean's Engine Reporter, Dec.* 10.

New Bill to Prevent Accidents in the Steam Marine Navy.†

There are at the present time 1110 steam vessels in the mercantile navy of Great Britain, and upwards of 3000 accidents have occurred betwixt steamers and sailing vessels within the last three years. The attention of government having been drawn to the numerous accidents, Capt. Denham, R. N., F.R.S., was appointed to proceed to the various ports to which the vessels belonged, and in many instances to the nearest places where the accidents occurred, to make inquiry into their causes, and succeeded in obtaining much valuable information on the subject. The gallant officer is now engaged with the legal authorities in drawing up a Bill, to be brought before Parliament next session, for the better regulation of the steam marine navy, and to compel those in charge of them

* From the London Railway Journal, No. 602.
† From the London Mining Journal, No. 798.

to adopt greater precautionary measures than they do at present, the Acts of Parliament previously passed being in so many instances inapplicable, and not by any means imperative enough, or sufficient to award punishment for neglect of the regulations. It is feared, however, that the new Bill will not be made perfect until all sailing vessels, as well as steamers, are compelled to show lights at night.—*Daily News.*

AMERICAN PATENTS.

List of American Patents which issued from January 14, *to February* 11, 1851, (*inclusive,*) *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

31. For an *Improvement in Tires for Railroad Car Wheels;* Theodore T. Abbot, Manchester, New Hampshire, January 14.

"The advantages of this improvement are, 1st, greater security to the wheel,—should one of the hoops break, enough will remain to prevent accident. The shape and position of the pieces, which form the tread, are the best possible to sustain the pressure. The tires in common use are liable to expand by the pressure, become loose, and draw off. This cannot happen to this kind of tire, for the pieces which form the tread, being distinct from those on the outside of it, if it were possible to expand them in this way, still the latter would remain unaffected. It is also the cheapest and most convenient method of substituting steel for iron."

Claim.—"What I claim, therefore, as my invention, is making the tires of car wheels by the combination of several distinct pieces, so arranged and disposed as mutually to support and confine each other, substantially in the manner above described."

32. For an *Improvement in Raising Carriage Tops;* John L. Allen, New Haven, Connecticut, January 14.

Claim.—"What I claim as my invention, is the application of a spiral spring, to operate upon the braces of a carriage top, so as to assist in supporting and elevating the top, substantially as described and shown."

33. For an *Improvement in Looms for Weaving Piled Fabrics;* E. B. Bigelow, Clinton, Massachusetts, January 14.

"The kind of fabric to be produced by my improved loom, are wrought double, that is, two cloths, one above the other, and the pile, or figuring warps, are alternately wrought or woven, first in one and then in the other cloth, the two cloths being kept at the required distance apart, by intersecting bars or plates, which determine the length of pile for the two fabrics, which is afterwards cut to separate them.

"In the power loom, as heretofore essayed, for the weaving of this kind of fabric, the interposed bars or plates which separate the two fabrics, and which pass between the dents of the reed, were made stationary or immovable, the pile being cut by means of a knife, which vibrates in slots near the front ends of the said bars or plates.

"This fixed position of the bars or plates, is a serious objection, as it prevents the proper vibratory motion of the cloth, at the time of the beat and the shedding of the warps.

"The object of my invention is to avoid this difficulty, and to this end, the nature of my invention consists in so connecting the intersecting bars or plates with the loom, that they shall be free to vibrate to the beat of the lathe, and to the shedding of the warps.

"And my invention also consists in the employment of a stop, or stops, to arrest the motion of the said bars or plates at a given point, so that the reed, in beating up the cloth, shall cause the woven cloth to advance on them."

Claim.—"What I claim as my invention, is connecting the intersecting bars or plates with the loom, substantially as described, so that they shall be free to vibrate, and yield to the beat of the lathe, and shedding of the warps, as described.

"And I also claim, combining with the said vibrating bars or plates, a stop or stops, to arrest them at the required point, substantially as described, that the continued beat of the lathe may cause the fabric to move forward over them, as described."

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34. For an *Improvement in Connecting and Disconnecting Hubs and Axles;* A. M. Billings, Claremont, New Hampshire, January 14.

"The nature of my improvement consists in detaching a wheel from its axle." * * * *

Claim.—"What I claim as my invention, is my device for detaching a wheel from its axle-tree, by means of the plate C C, acting as a wrench for unscrewing the nut B, which holds the wheel to the axle, said plate being advanced and withdrawn by the screw D, substantially in the manner herein described."

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35. For an *Improvement in Tuyeres;* Joseph Dorwart, Morgantown, Pennsylvania, January 14.

"My improved tuyere consists of an upright vessel, having a chamber within it, which is closed at the top by a movable grate, and at the bottom by a sliding shutter; the vessel is furnished with a wind-pipe, by means of which the blast from the bellows enters the chamber; the wind-pipe, at its junction with the chamber, curves upwards, to cause the air to impinge more directly upon the grate bars, and a curved partition is introduced within the chamber, in such manner, that while it assists in turning the blast upwards, it allows any particles which may fall through the grate bars to pass it, and lodge at the bottom of the chamber, where they cannot obstruct the blast, and whence they are removed by withdrawing the sliding shutter."

Claim.—"What I claim in the foregoing as my invention, is the curved partition in the air chamber, placed opposite the orifice of the wind-pipe, with its lower edge extending beneath this orifice, the arrangement and construction of the partition being such, that it serves the double purpose of directing the blast upwards, and facilitating the descent of the cinders, as herein set forth."

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36 For an *Improvement in Rotary Pumps;* J. Stuart Gwynne, City of New York, January 14.

"The general features of the machine are a hollow revolving piston, within which the water is received at the centre, and from the periphery of which it is thrown, by centrifugal power, into an outer and stationary case, whence it passes into the outlet pipe, through which it is discharged."

Claim.—"I do not claim to be the inventor of the centrifugal pump. I do not claim simply using collars extending from the openings in the outer case to the openings in the piston case, to prevent the water or air from passing between said cases; nor extending the inlet or suction pipe inwards in such a manner as to supply the place of one of said collars, this having already been done; but I only claim thus extending said pipe when the collar on the opposite side is made adjustable, and the parts so arranged that the joints of the piston case, with said pipe and collar, may be tightened as they wear, by tightening the adjustable collar only as described; the piston and case, and the suction pipe, being constructed substantially as herein described."

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37. For an *Improvement in Changing a Reciprocating into a Rotary Motion;* Joseph Harris, Jr., Boston, Massachusetts, January, 14.

Claim.—"What I claim as my invention, is the application to steam or other engines, or machines, of a mechanical arrangement, whereby the effect of the applied power is rendered equal, or nearly so, both on the outward and return strokes, of any reciprocating or vibrating movement, using for that purpose the aforesaid combination of the cranks, connecting rods, and oscillating lever, or their equivalents, as described in the above specification, and shown in the accompanying drawings."

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38. For an *Improvement in Cast Iron Car Wheels;* George R. McFarlane, Hollidaysburg, Pennsylvania, January 14.

"The advantages possessed by a wheel thus constructed are, that, while the curvilinear shape of the arms at their connexion with the rim, gives to the wheel all the strength and

advantages possessed by a plate or disk wheel, the openings between the arms allowing the centre of the wheel to give in cooling, the contraction is more easily regulated than in a plate wheel; and that the wheel may be cast with a solid or split heel, as may be preferred, and may be moulded either by bedding in or turning over."

Claim.—"What I claim as my invention, is the mode of constructing a cast iron car wheel, by the use of spokes or arms, composed in part of portions of a hollow cone, connected by brackets, and in part by straight spokes or arms, forming a continuation of plates and spokes, possessing the advantages and obviating the objections of both."

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39. For an *Improvement in Reflectors for Street Lamps;* Hugh Sangster and James Sangster, Buffalo, New York, January 14.

"Our invention consists in a lamp, which is provided with a double, triple, or quadruple concave reflector, placed between two or more burners, the number of burners corresponding with the number of faces of the reflector, and in making each face of the reflector of a number of concave rings, concentric in outline, as hereinafter described and shown."

Claim.—"What we claim as our invention, is making the faces of the reflector in concave rings, substantially in the manner and for the purposes herein set forth."

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40. For an *Improved Steering Apparatus;* Joseph E. Andrews, Boston, Massachusetts, January 14.

"The nature of my invention consists in transmitting the power applied through the steering wheel to the rudder, by means of two cranks, set in opposite directions on a shaft having fixed bearings; the said crank being connected, by connecting rods having universal joints, to projections or arms on the rudder post, and the power being applied to the shaft upon which the cranks are fixed, by means of an endless screw on the axle of the steering wheel gearing into a worm wheel on the shaft. This apparatus is very rigid and unyielding, and at the same time works with the greatest ease and freedom, and is not at all likely to get out of repair by wear or accident."

"*Claim.*—"What I claim as new in my invention, is the combination of the cranks H H, and the connecting rods K K′, which are attached by universal joints to the projections or arms X X, on the rudder post, the cranks having a worm wheel G, on their shaft or axis, which gears with and is actuated by an endless screw F, on the axle or shaft of the steering wheel, the whole of the parts being arranged in the manner substantially as described."

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41. For an *Improvement in Carriages;* John Jones, Clyde, New York, January 14.

"The nature of my invention consists in constructing carriage reaches in such a manner as to prevent a zigzag motion, on plank and descending roads; and also in an arrangement to allow the carriage to cramp any desired degree, without having the wheels strike the body."

Claim.—"What I claim as my invention, is the arrangement of two bars or reaches, placed in connexion with the straight reach, as above described, and in combination with the spring rod and cross bar, substantially in the manner described."

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42. For an *Improved Propeller;* Andrew W. Thompson, Philadelphia, Pennsylvania, January 21.

Claim.—"What I claim as my invention, is a propeller, constructed as herein described, in such manner that any one of its blades, in any line drawn either parallel or perpendicular to its entering edge, shall have the curvature of a parabola, produced as herein set forth."

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43. For an *Improvement in Brick Presses;* Jacob Scheitleir, Philadelphia, Pennsylvania, January 21.

"The nature of my invention consists in so constructing a brick machine that the clay, as it is dug from the ground, may be placed in the hopper, mixed, screened, and pressed into bricks, and delivered from the moulds ready for the kiln, without any farther manual labor than the mere placing of the clay in the hopper."

Claim.—"1st, I claim, in combination with the clay ducts and alternating carriage of

moulds, the rods *g'* with their knives H', (for the purpose of cutting off and forcing into the moulds the regular quantity of clay,) and sliding plate or gate Z, for the purpose of opening and closing the communication between the clay ducts and moulds, as herein described and represented.

"2d, I claim the arrangement of the pins *n n*, connecting rods *o o*, and standard N, with its arm Q, for the purpose of removing the brick after it is raised from the mould, when the same are operated by means of the cranks, as herein described and shown."

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44. For an *Improvement in Stoves;* George H. Thatcher, Albany, New York, January 21.

Claim.—"Having thus described my improvements in the combined open and air-tight stoves, and shown the advantages of the same, I wish it to be understood, that I do not claim the device of sliding doors between parallel jambs or plates, for the purpose of concealing the same.

"But what I do claim as new, is the providing of the sliding doors A with flanches H H, on their vertical edges; the rear flanches serving the purpose of hinges in opening and closing the same, and also serving to form air-tight joints when the doors are closed; and the front flanches serving, in connexion with the projecting ends E E of the side plates B B, to relieve the appearance of a joint when the doors are opened, as before described.

"I also claim the providing of the side plates B B, with projecting front plates F F, for the purpose of forming fronts to the spaces into which the doors are slid when open, to conceal the same; and in connexion with the rear flanches H H to form the hinges of the doors when closing the same, and also to conceal a portion of the front flanches when the doors are opened and slid back, as described."

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45. For an *Improvement in Convertible Plough-Stocks;* Edward T. Parker, Berkley, Alabama, January 21.

"My plough and cultivator is adapted and designed for breaking up the soil and sub-soil, and in cultivating it."

Claim.—"What I claim as my invention, is so constructing a sub-soil plough, with removable mould board and cutter, in combination with the tri-pronged cultivating teeth, that the same stock may be used either for a sub-soil plough, or common ploughing, substantially the same as herein set forth."

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46. For an *Improvement in Tools for Embossing Backs of Books;* Charles Starr, City of New York, January 21.

"The nature of my invention relates to the circular or cylindrical tools used by bookbinders for embossing, lettering, and gilding covers of books, more especially their backs. It consists in the employment of a loose hollow cylinder, or cylinders, fitted upon a solid cylinder or roller, and having spaces cut through to admit of loose tools being secured to the solid or foundation cylinder or roller; the edge of the space in the outside cylinder forming the frame margin or outline of the panel or ornament, and the inside being filled with ornaments of any design, suitable to the taste of the designer or binder."

Claim.—"I do not claim forming various devices by gluing or securing loose or detached tools to a surface, as that is common.

"But what I do claim as my invention, is forming circular embossing, gilding, or lettering tools of any required pattern for embossing, gilding, and lettering book covers, by having a case or hollow metal cylinder B, fitting on a roller A, and having an opening *b b*, or openings, in it of any required form, for a panel or other border; the part of the periphery of the roller A within the opening or openings in the case, having any required number of small tools *c c c*, of any suitable form or pattern, secured to it, the surfaces of said tools standing even with the outer face of the case or cylinder B, or by the employment of any number of tools, consisting of parts of a hollow cylinder secured to a solid cylinder, substantially in the manner herein described."

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47. For an *Improved Lee-Way Indicator;* A. A. Wilder, Detroit, Michigan, January 21.

"The said improvement consists in attaching the vane at one end by a pin to the bottom of the rod, so that it is capable of taking a position in line with the rod, or at an angle to it, a spring of convenient form, hereafter described, being attached to one side of the

rod, opposite to the direction the vane takes when in use, for the purposes both of keeping the vane in position, in line with the keel when in use, and holding it secure within or above the keel when not in use."

Claim.—"What I claim as my invention, is hanging the vane E loose at the bottom of the rod C, which carries or communicates with the pointer, and holding it either in position for operation, or secure within the vessel above the bottom of the keel, by means of a spring *d*, or its equivalent, operating substantially as herein set forth."

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48. For a *Horse-Shoe Nail Machine;* Daniel Wilson, Jr., assignor to D. Wilson, Jr., and H. M. Bird, North Chelmsford, Massachusetts, January 21.

"The combination of parts necessary to cut and head the nail is thus much simplified, the same being produced by the peculiar construction, arrangement, and mode of operating them, as described and represented."

Claim.—"What, therefore, I claim, is the simple combination of the punch, the slotted beddie, the heading die, the header slide, discharging orifice and header, as arranged, constructed, and made to operate together, substantially as specified; or, in other words, their arrangement and construction, essentially as explained, whereby they are made, to separate the nail blank from the rolled plate, to move it downwards upon the header slide, to cause the header slide to advance, in the mean time to hold the nail blank by means of the punch and header slide, to cause the header slide to slide underneath the nail, while it is so held, to carry the header against the nail and head it, to cause the header slide to retract or move backwards far enough to carry or move the discharging orifice directly under the nail, and so that the nail may be forced down into or through such orifice by the further depression of the punch, which next takes place, and finally, to elevate the said punch to its first or highest position."

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49. For an *Improvement in Stoves;* Elihu Smith, Albany, New York, January 28.

Claim.—"What I claim as my invention, is the combination of a transparent water vessel, with mica covered or other transparent openings in the top of a stove plate, and a mirror placed upon a stove top, as herein represented and described."

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50. For *Improvements in Metal or Second Patterns for Castings;* Francis N. Still, City of New York, January 28.

Claim.—"What I claim as my invention, is preparing second patterns by moulding metal patterns in two part moulds, and then separating the two parts of the mould, the pattern being left in the sand to cast a plate fitted to the metal pattern, so moulding as specified, so that the pattern can be attached to the plate, and the two be used in moulding to produce castings, substantially as described."

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51. For an *Improvement in Abdominal Supporters;* Moses L. Knapp, Painesville, Ohio, January 28.

Claim.—"What I claim as my invention, is the construction of hip springs, with split or divided ends, forming elongations of the same strip of steel, the front springs having slots and pivot holes, and the back springs having two or more graduating pivot holes, to be used in combination with the adjusting screw and pivot screws, as herein substantially set forth."

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52. For a *Swivel-nibbed Key;* James Hanley, City of New York, January 28.

"My improvement consists substantially in making the end of the key that passes through the lock to revolve, irrespective of the particular mechanical means by which it is attached to the key."

Claim.—"I therefore claim as my invention, the making the exposed ends of keys in such a manner that they may revolve freely upon the other parts of the key, substantially in the manner and for the purposes described."

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53. For an *Improvement in the Hydraulic Ram;* William Field, Jr., Providence, Rhode Island, January 28.

Claim.—"I claim as my invention and improvement, the hinge valve C, opening up-

wardly and inwardly, at or near the upper end of the inclined plane or drive pipe C D of the hydraulic ram; said valve being placed in a box made of brass, or any other suitable materials, which valve, by closing on the reaction of the water in the drive pipe, prevents the said reaction from disturbing the water in the spring or reservoir. The box of said valve is bolted to the drive pipe, as represented in the annexed drawing; and said valve may be a hinge valve, or any other suitable valve."

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54. For an *Improvement in Drawing Regulators for Spinning Machines;* Newell Wyllys, South Glastenbury, Connecticut, January 28.

"The object of my invention consists in such an arrangement of mechanism in connexion with the condensing tube or trumpet, that when the sliver is of the proper size, the trumpet occupies a certain neutral position, in which the force exerted by the weight to move the trumpet in one direction, and that exerted by the sliver to move it in the opposite direction, balance each other; and whenever the sliver is too thick, the former force preponderates, the trumpet is moved in advance of its neutral position, the effective length of the lever through which it acts is diminished, and the weight tends to return the trumpet to its neutral position, with correspondingly increased force; whenever the sliver is drawn too thin, the force of the weight preponderates over that exerted by the sliver, the trumpet is moved back of its neutral position, the effective length of the lever through which it acts is increased, and consequently the sliver tends to return the trumpet to its neutral position with correspondingly increased force."

Claim.—"What I claim as my invention, is the arrangement of the trumpet as herein described, in connexion with the system of weighted levers, escapement and reversed cone pulleys, whereby the force required to move the trumpet is made to vary under different circumstances to a sufficient extent to prevent over sensitiveness in the mechanism, will change the relative speed of the drawing rolls to inequalities in the slivers, while at the same time but little force is required to effect such changes, thus proportioning the draw more nearly than heretofore to the quantity of fibre in the sliver, and thereby rendering the latter of more uniform diameter and density."

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55. For an *Improvement in Pens for Ruling Paper;* Alfred Hathaway, Boston, Massachusetts, January 28.

Claim.—"Whatever may be the number of thicknesses of metal the back bar and pens are composed, my improvement, and what I claim, consists in not only making the upper one larger than the others, but in making it the marking part, and soldering the next one below it to it, as specified. Such improved mode of making the pen or pens, I claim as my invention, and whether the plates of metal placed upon one another be of different metals, or of different thicknesses of metal, as described.

"And I also claim the improvement in the construction of the back bar, the same consisting in making it with a slit or opening *u* between any two pens, and extending nearly or quite up to the vertex of the angle or bend of the bar, as specified, the same producing the advantage above mentioned.

"And when the pen is composed of more than two thicknesses of metal, I claim the improvement by which one single soldering of the upper and lower parts together suffice to bind or keep all the parts together or in place, the said improvement consisting in making the lowest thickness of metal larger than any of the others, except the first or upper, and marking one, as described.

"And I also claim the method of making the pens and back bar, as shown in figs. 5 and 6, when the same are composed of two different thicknesses of metal, or of two plates of different metals, the said improvement consisting in making the lower plate to enclose or lap over the one or others above it, as seen at *g* in fig. 6, and thus make the back bar of one more thickness of metal than the pens are composed of.

"And I also claim to make the different thicknesses of the pen of different metals, as specified."

RE-ISSUES.

1. For an *Improvement in a Machine for Bending or Setting Felloes for the Wheels of Carriages;* Edward Reynolds, Haddonfield, New Jersey; patented July 17, 1835; extended July 11, 1849; re-issued January 1, 1851.

"The object of my invention is to bend the felloes of wheels, by machinery, and con-

sists in bending the wood, which has been properly prepared, by the use of a cylinder, or segment of one, in combination with an auxiliary friction roller, or its equivalent, between which and the cylinder the piece of wood to be bent is placed, one end being securely attached to the cylinder."

Claim.—"What I claim as my invention, is the method, substantially as described, of bending felloes for carriages, by means of a cylinder, upon which the felloe is bent, and a friction roller, or its equivalent, against which it is bent, substantially as described, when used in connexion with a strap, for preventingt he wood from splitting on its exterior surface, or otherwise."

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2. For an *Improvement in Sofa Bedsteads;* Russell Scarritt, St. Louis, Missouri; patented October 8, 1850; re-issued January 7, 1851.

Claim.—"What I claim as my invention, is the combination of the frames D D, which are of the same form as the sofa ends F F, with the said sofa ends, substantially in the manner and for the purpose as herein set forth, to wit: when the back A is elevated, to convert the sofa bed into a sofa, the frames D D must be swung inwards against the sofa back, to retain it in an elevated position, and to throw the said frames out of the way and out of sight; and when it is desired to change the sofa bed from a sofa to a bed, the said frames D D can only be swung outwards into a line with the sofa ends F F, so that the ledges *l l*, on the inner sides of the same, will unerringly catch and retain the back A, when it reaches a horizontal position as it is thrown backwards, in which position the sofa ends F F, and the swinging frames D D, will form an ornamental and uniform head and foot to the bed form of my improved sofa bed.

"I also claim the placing of the pivots *t t*, which suspend the mattrass frame A, such a distance from the lower or inner edge of the same, that when the said mattrass frame is thrown backwards into a horizontal position, the lower or inner edge of the mattrass A′, will, by that movement, be thrown forwards, and press against the rear edge of the mattrass B′, with such force as to form a close and an elastic joint between the two, and thereby furnish an extra width to the bed form of my improved sofa bed, substantially in the manner herein set forth.

"I also claim the projection of the mattrass A′ below the pivots that it turns upon, in combination with the movement of the mattrass B′ on hinges located at its front edge, by means of which a firm and close joint is formed between the rear edge of the mattrass B′ and the face of the mattrass A′, when they are arranged in the form of a sofa, which joint aids in retaining the said mattrass A′ in an elevated position, substantially as herein set forth."

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3. For an *Improvement in Machines for Folding Paper;* Edward N. Smith, West Brookfield, Massachusetts, assignor to The American Paper Folding Company, Springfield, Massachusetts; patented November 27, 1849; re-issued January 7, 1851.

Claim.—"What I claim as my invention, is the method of folding sheets of paper mechanically; by means of a reciprocating straight edge, or its equivalent, which strikes the sheet where the fold is to be made, and forces it into a recess or space between two surfaces, through which it can be delivered, in combination with a mechanism which presents the sheet at the proper place and time to make the fold or folds at the proper line or lines, substantially as described.

"I also claim the method of completing the folds in sheets of paper, by passing them between converging surfaces, in combination with the method of forming the folds, substantially as described.

"And, finally, I claim the moving surfaces of endless belts, or their equivalents, on which the sheets of paper are extended, and by which they are moved, in combination with the method of making and completing the folds, substantially in the manner specified."

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4. For an *Improvement in Machinery for Making Mouldings;* Alfred T. Serrell, City of New York; patented May 16, 1848; re-issued January 7, 1851.

Claim.—"What I claim as new and of my own invention, is the combination of the feed and pressure rollers, constructed and operating substantially as described, with one or more cutters or planes, for giving the proper form or dressing to the moulding, when said combined parts operate upon material which has been sawed or cut, as nearly as may be

convenient, into the general form of the moulding to be produced, as herein described, for the purpose of economizing the material, or facilitating the operation."

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5. For *Improvements in Sewing Machines;* Sherburne C. Blodget, Georgetown, Massachusetts, and John A. Lerow, Boston, Massachusetts; patented October 2, 1849; reissued January 14, 1851.

"Our machine is distinguished from all other sewing machines now known to us, in several points very essential to the accomplishment of any valuable results from the machine, and any real practical advantages over hand work."

Claim.—"What we claim as our invention in the above described rotary sewing machine, is arranging the shuttle which carries the filling thread, so that it shall revolve horizontally in a circular shuttle-race, said shuttle being constructed with a curved front and pointed nose, which shall travel in a circular guiding groove sunk below the bottom of said race, so that the shuttle shall invariably pass through the loop formed in the needle thread, all as herein above set forth."

"We also claim the pad or washer under the spring arms which carry the shuttle, for keeping the filling thread straight, as herein before explained. Furthermore, we claim the combination of the wide spring c' c', and the bent lever spring f' f', operating as herein above described, or any contrivance substantially equivalent thereto, for relaxing the needle thread, when the loop is to be formed, and holding it rigidly when each stitch is to be tightened, as herein above set forth.

"We also claim the converging nipper springs, through which the needle, &c., passes, to keep the thread up and prevent the needle from splitting or breaking it, as herein above set forth.

"We also claim the combination and arrangement of the spring arms q' q, q' q', with the cam ledge s' s', or any other means essentially the same, for the purpose of disconnecting, alternately, said arms from the shuttle, for the purpose of allowing the shuttle to pass through the loop, as herein described and represented."

DESIGNS.

1. For a *Design for a Cook Stove;* William C. Davis, Cincinnati, Ohio, January 1.

Claim.—"What I claim herein as new, is the ornamental design for a stove, substantially as represented in the accompanying drawings."

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2. For a *Design for a Stove;* Charles Gilbert and Witchell G. Hallman, assignors to Charles Gilbert, Philadelphia, Pennsylvania, January 1.

Claim.—"What we claim as our invention or production, is the ornamental design, as above described, and represented in accompanying drawings."

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3. For a *Design for Stoves;* Elihu Smith, Albany, New York, January 7.

Claim.—"What I claim as my production, is the combination and arrangement of ornamental figures and forms, represented in the accompanying drawings, forming, together, an ornamental design for a parlor stove."

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4. For a *Design for Stoves;* Joseph G. Lamb, Cincinnati, Ohio, January 21.

Claim.—"What I claim as new and my invention, is the arrangement and combination of the above described and represented shapes, figures, ornaments, flutes, and mouldings into the above specified design, for coal heating stoves, substantially as above shown."

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5. For a *Design for Stoves;* S. W. Gibbs, Albany, New York, assignor to North, Harrison & Co., Philadelphia, Pennsylvania, January 21; anté dated December 31, 1850.

Claim.—"What I claim as my invention, is the ornamental design for a stove, as herein described and represented in the annexed drawings."

6. For a *Design for Cooking Stoves;* Samuel W. Gibbs, assignor to Ira Jagger, William B. Treadwell and John S. Perry, Albany, New York, January 21.

Claim.—"What I claim as my production, is the combination and arrangement of ornamental figures and forms represented in the annexed drawings, as making an ornamental design for a cooking stove."

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7. For a *Design for Stoves;* Conrad Harris and Paul W. Zoiner, Cincinnati, Ohio, January 28.

Claim.—"What we claim as our invention, is the combination and arrangement of the above represented scrolls, foliage, figures, and mouldings, into an ornamental design for coal and wood parlor stoves, to be known and called 'Harris & Zoiner's Patent Coal and Wood Parlor Stove.'"

RE-ISSUE FOR DECEMBER, 1850.

1. For an *Improvement in the Manner of Constructing Railroad Carriages, so as to Ease the Lateral Motion of the Bodies thereof;* Charles Davenport and Albert Bridges, Cambridgeport, Massachusetts; patented May 4, 1841; re-issued December 3, 1850.

"The object of our improvement is to obviate the effects of the above lateral shocks, by mechanism suitably arranged."

Claim.—"We do not claim as our invention the making stationary the turning bearing, or contrivance which supports the railway 'long car,' or carriage body, on the truck frame, and allows a horizontal rotary motion of the truck frame independently of the car body or frame, as this has been done before the date of our invention; but in order to obviate the effect of lateral shocks, as specified, as well as for sundry other purposes.

"What we do claim, is the connecting the said bearing to the truck frame of the above described kind, resting on four wheels or more, by a mechanism substantially such as described, that shall not only allow such turning bearing independently of the wheels and axles a lateral play, movement or movements, in directions transversely of the carriage, but bring or move it back to its central position, after the lateral deflective force has ceased to act."

DESIGNS FOR DECEMBER, 1850.

1. For a *Design for Stoves;* Samuel Pierce, assignor to Johnson, Cox & Fuller, Troy, New York, December 3.

Claim.—"What I claim as new, is the design of ornament and configuration of cook stoves, substantially the same as herein described and represented."

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2. For a *Design for Stoves;* Morris Smith and Benona S. Gleason, Le Roy, New York, December 3.

Claim.—"Having thus described the nature of our new design, what we claim therein as new, is the design of ornament and configuration, constituting in construction a new design of stove, substantially the same as herein described and represented in the annexed drawings."

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3. For a *Design for Stoves;* Charles A. Lambard, Augusta, Maine, December 10.

Claim.—"What I claim as my production, is the combination and arrangement of ornamental figures and forms, represented in the accompanying drawings, as making an ornamental design for an air-tight cooking stove."

FEBRUARY.

1. For an *Improvement in Lard Lamps;* Delamar Kinnear, Circleville, Ohio, February 4.

"The nature of my invention and improvement consists in forming a chamber *i* of the form of a section of a frustrum of a pyramid, in its cross section, above the ordinary cham-

ber that contains the liquid for producing the light, so as to make the sides of said chamber perform the two offices of side chambers, for preventing the spilling or waste of the liquid lard or oil when the axis of the lamp is made to deviate from a perpendicular line, and assume a horizontal position, or an approximation thereto, in handling the lamp carelessly, and as side channels or dovetail grooves for the slide or cover to move in when a slide cover or stopper is substituted for a screw cap stopper."

Claim.—"I disclaim the invention of every part of the lamp except the angular chambers *i*, or grooves above the reservoir *a*, on either side of the wick tubes *b c*, for preventing the spilling or waste of the oil when the stem of the lamp is held in a horizontal or inclined position; and also the dovetailed slide *d*, and the aforesaid angular channels or grooves *i*.

"I claim as my invention in combination with a lamp of the peculiar form and construction represented in the annexed drawings, or other form substantially the same; said channels or grooves serving also to receive and hold the sliding cover *d*, used for closing the supply opening, instead of the ordinary screw cap, and in combination with the aforesaid angular channels.

"I also claim the said sliding cover *d*, when made with correspondingly shaped sides to fit and move in said channels, all as herein described and represented."

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2. For an *Improved Method of obtaining Motive Power;* William Mt. Storm, Troy, New York, February 4.

"The fundamental principle of my invention consists in producing and applying as a motive force, the sudden expansion or increased tension produced by the intensely rapid combustion, or the explosion of a solid combustible, in a compressed gaseous supporter of combustion."

Claim.—"What I claim is, actuating an engine, such as are now usually driven by steam, or of any convenient form, by means of the combustion, allied to an explosion, of a measured or detailed quantity of a charcoal (or other solid carbonaceous fuel, similar in nature and of like effect,) in a measured quantity of highly compressed air, (or oxygen,) said combustion being effected in a vessel which, at that time, is not in connexion either with the reservoir or main source of compressed air, or with that of the charcoal, and the gases resulting from each separate and distinct explosion being allowed to act on the pistons, or their equivalents, before the other charges are introduced into the exploding or combustion vessel; the whole operation being effected through the agency of apparatus in nature substantially such as are herein specified, or apparatus that shall effect the whole operation in the manner claimed.

"I also claim, in actuating an engine as just claimed, using the combustible in a granulated or pulverized form, for the purposes and various reasons made known."

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3. For an *Improvement in Cooking Stoves;* Backus A. Beardsley, Waterville, New York, February 4.

"My invention consists in constructing a cooking stove in such manner that the heated air and gaseous products of the combustion of the fuel are more equably and perfectly distributed under the bottom of the lower oven, thereby causing a more even heating of the oven bottom, and that the distribution of the heat can be varied to accommodate it to the draft of the chimney under different circumstances. At each side of the said oven I also fit an air-box, whose interior communicates with the flue space beneath the oven, and which tends to keep these sides of the oven at the proper temperature without the use of side flues."

Claim.—"What I claim as my invention, is the construction of the adjustable and sliding partitions (G and G, fig. 3,) by which the draft of the stove and the distribution of the heated air under the bottom of the lower oven is varied and controlled at pleasure, adjusting the same to the particular place and circumstances of each stove; the whole being arranged and constructed substantially as set forth and described."

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4. For an *Improvement in Machines for Preparing Hides;* Thomas W. Jones, Philomath, Georgia, February 4.

"My invention consists in drawing the hides or leather in a continuous manner beneath sets of stampers, which occupy such positions with respect to each other that the shoes of

one set are opposite the spaces between the shoes of the other, and which being caused to rise and fall alternately, beat and press the hide or leather drawn continuously between them."

Claim.—"What I claim as my invention, is the method of consolidating and smoothing leather by drawing it with a continuous motion beneath a series of stampers, which alternately rise, fall, and rest upon its surface, a portion of the stampers being at all times in contact with the leather, so that the smoothing of its surface is constantly going on simultaneously with the consolidation by the blows of the falling stampers."

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5. For *Improvements in Fancy Check Power Looms;* Enoch Burt, Manchester, Connecticut, February 4.

"I wish it to be clearly understood that I do not limit myself to the precise construction of the various parts, and the arrangement of them as above specified, as these may be varied within the principle of my invention."

Claim.—"What I claim as my invention, is the method substantially as above described, of regulating the packing ring interposed between the steam wheel and head of the cylinder or outer casing of rotary steam engines, by combining with the said packing ring a series of segment wedges, operated simultaneously in manner substantially as described."

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6. For an *Improved Ship's Light;* Leonard Goodrich, City of New York, February 4.

Claim.—"I claim hanging the screwed socket or frame C containing the glass, so as to turn freely within a frame H, which swings on a hinge K K I, provided with a slot *k*, or its equivalent, whereby the socket C can be screwed into or unscrewed from the fixed socket B, and when unscrewed, be swung back, substantially as herein described."

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7. For an *Improvement in Grain Harvesters;* Sidney S. Hurlbut, Racine, Wisconsin, February 4.

Claim—"Having thus described my improved reaping machine, I first claim combining with a reaping machine a self-acting weighing apparatus for weighing the grain into any required quantity, to form sheaves or bundles of a uniform weight, as described, depositing the same upon the ground in readiness to be tied, whilst the reaping machine is drawn forward and cuts the grain; the said weighing apparatus being made adjustive, so as to increase or diminish the size of the bundles at pleasure; and this I claim, whether the weighing apparatus be made and arranged as described, or in any other way which is substantially the same, or whether combined with the aforesaid reaping machine, or any other of a similar character.

"2d, I likewise claim the combination of the bent holders W W, with the inclined endless conveyor for holding the grain thereupon, whilst conveying it to the weighing and depositing apparatus, as aforesaid."

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8. For an *Improved Scraper;* Charles Schofield and George J. Johns, Albion, Illinois, February 11.

Claim.—"Having thus fully described our invention, what we claim as new, is the combination and arrangement of the scoop A, standard B, beam G, arm E, and handles H, in such manner, that when the scoop is tipped, it will revolve sufficiently far to allow the earth to slide off, and then remain in such position as that the operator, by a slight movement of the handles, can level down the earth with the scoop, and without the aid of another hand or another scraper, as herein described and represented."

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9. For an *Improvement in the Seeding Apparatus of a Seed Planter;* Samuel and Morton Pennock, Kennett Square, Pennsylvania, February 11.

Claim.—"What we claim as our invention, is the employment of the ring or cylinder A, having projections on its periphery, in combination with the notched and toothed cylinder gauge caps C D, constructed, arranged, and operated, substantially in the manner herein set forth, for increasing and diminishing the size and number of the distributing receptacles, as represented in figures 1, 2, 3, 4, 5, and 6.

"We likewise claim the combination of the helical spring I, screw shaft E, flanched nut N, and clamp nut H, with the notched and toothed cylindrical gauge caps to which the ends of the spring are attached, for turning the gauge cap, in order to change the relationship of the teeth or projections of one of the caps with the teeth or projections on the adjacent cap, for enlarging the distributing receptacles, as described in the foregoing specification, as represented in fig. 5 in the annexed drawings.

"We also claim the combination of the screw shaft E, clutch nut G, clutch washer F, and clamp nut H, with the toothed cylinder caps C D, for enlarging or diminishing the distributing receptacles, as described and represented in fig. 7.

"We likewise claim the modifications of the distributing apparatus in their simplified forms, as represented in figures 14 and 15, the several parts being operated in the manner herein set forth."

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10. For an *Improvement in Sewing Machines;* William O. Grover, Boston, and William E. Baker, Roxbury, Massachusetts, February 11.

"The distinguishing feature of our invention, consists in the use of two needles, instead of one needle, and a shuttle carrying a filling thread, either by a rotary or a transverse movement, and the forming of a double loop stitch, by the peculiar movements of said two needles and their respective threads.

Claim.—"What we claim as our invention, is the use of two needles, operating alternately, one working vertically and the other horizontally, substantially as herein above described, and uniting two pieces of cloth, or forming the seam, by means of the double loop stitch, as herein above set forth."

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11. For *Improvements in Operating the Waste Gate of Hydraulic Rams;* John Osborn, Hamden, Connecticut, February 11.

"The nature of my invention consists in the application of a regulator, acted upon by a float in the spring or source from which the water runs to drive the machine, which regulator increases or lessens the stroke of the waste valve, or shuts it by means of levers or other means, according to the rise or fall of the water in the spring or source, thus proportioning the use of the water to the quantity in the source. And it further consists in a self-acting arrangement for opening the waste valve, and thereby starting the machine, when the water in the source is sufficiently high to use, after the ram has been stopped by a deficiency in the supply."

Claim.—"What I claim as my invention, is the use of the regulating slide M, and nut, or other similar arrangement, in combination with the levers, wires, springs, rods, weights, or other devices, substantially similar to those described, for adjusting the waste valve, and operated on by, and in connexion with, a float F at the spring or source, which float rises or falls with the water.

"I also claim the use of the hammer R, resting or falling on a springing piece S, for opening the waste valve D, or starting the hydraulic ram, and worked as described, or in any other similar manner."

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12. For a *Method of Securing Ranges of Short Plank in Pavements;* Joseph E. Ware, St. Louis, Missouri, February 11.

"The nature of this invention and improvement consists in a method of securing certain parts of planking on streets in such a manner as to permit their removal, so as to reach pipes or sewers underneath; the planks being cut in short pieces for such ranges, and with such bevels or overlaps as to cause one piece to aid in holding down the other."

Claim.—"What I claim as my invention, is the method above described of securing ranges of short pieces of planking of a street or road in longitudinal lines over water or gas pipes, by means of screws or keys with staples, aided by the double bevel of the short planks, and the ends of the permanent interval planks severally holding and permitting of the easy removal of such short piece."

MECHANICS, PHYSICS, AND CHEMISTRY.

Description of the Design for the Building for the Exhibition of all Nations, and of the gradual development of the method of construction employed. By MR. PAXTON.*

The author began by stating, that the Great Exhibition Building was the development and result of a very long series of experiments, made by him at Chatsworth, in the erection of the different horticultural buildings there, on which he had been engaged since the year 1828. The pine-house, built in 1833, was the first in which the ridge-and-furrow roof—an essential feature in the great building—was employed. This roof was contrived by the author, so that the glass in it might be more nearly at right angles to the slanting and weak, though valuable, rays of the morning and evening sun, than the glass used in straight roofs. So well was it found to answer, that in 1834 he built a green-house, 97 feet 6 inches by 26 feet, with a mean height of 14 feet 6 inches. This building, even under the old glass tax, cost only 2*d.* per cubic foot. It was followed, in 1836, by a "curvilinear" hot-house, 60 feet by 26 feet, so called from the roof being a quarter circle: here the Victoria Regia first flowered in 1849. In the following year the great conservatory was commenced; and, in order to economize labour in its construction, the author invented a machine for forming the sash-bars, by which he effected a saving of £1400, and for which the Society of Arts, in 1841, gave him the silver medal. This has been the type of all the machines for wooden sash-bars since used. For this building sheet glass was first made, by the Messrs. Chance and Co., of the length of 4 feet,—nothing beyond 3 feet having ever before been made. The great conservatory is 277 feet long, 123 feet wide, and 67 feet to the crown of its domed roof.

In a conservatory at Darley Dale, in 1840, the author first employed the ridge-and-furrow roof on a level,—that is, neither curvilinear nor inclined, as in the former cases. The breadth of this building is 17 feet; and so successful was it, that, in a letter from the proprietor, it was said to be constantly used as a sitting-room by his family. This was more extensively carried out in the new Victoria Regia house, 60 feet 6 inches in length and 46 feet 9 inches in breadth, with a clear span for the roof of 33 feet 6 inches; and which, on its small scale, is a perfect type of the great building.

The Industrial Building.

The inducement for offering a design for this building was the following:—When plans for the structure were sent in by various parties to the Royal Commissioners, many forcible reasons were urged, in the daily papers, against the propriety of erecting a large building of bricks and mortar in Hyde Park. It was then that the author turned his attention to the matter; and he became at once convinced, that the least objectionable structure, to occupy a public park, would be an erection of cast iron and glass; whilst, at the same time, a building of this description would be the

* From the London Journal of Arts and Sciences, for December, 1850.

very best adapted for the purposes of the exhibition. The time for receiving the designs had expired; but, from having the whole matter already digested, and the system of ridge-and-furrow *flat* roofs so fully in his mind, it only required the adaptation of the principle, on a large scale, to suit the vast building for the exhibition. His plans were got up in about ten days, and ultimately received the approval of the Commissioners.

The design for the building was planned—first, with particular consideration as to its fitness for the object in view, namely, the Exhibition of 1851; secondly, its suitableness for the site proposed; and lastly, with a view to its permanence as a winter garden, or vast horticultural structure, or a building which might, if required, be again used at any future period for a similar exhibition to that of 1851.

One great feature in the present building is, that no stone, brick, or mortar, need be used; but the whole is composed of dry material, ready at once for the articles to be exhibited. By combination of no other materials but iron, wood, and glass, could this important point be effected; which, when we consider the limited period allowed for the erection of so stupendous a structure, may almost be deemed the most important object. The absence of any moist material in the construction, together with the provision made for the vapors which must arise and be condensed against the glass, enables the exhibitor at once to place his manufactures in their respective situations, without the probability of articles, even of polished ware, being tarnished by their exposure.

It may be important here to state, that it is unnecessary to cut down any of the large timber trees, provision being made, by means of a curvilinear roof over the transept of the building, for them to stand beneath the glass, and by a proper diffusion of air they will not suffer by the enclosure. (Mr. Paxton here proceeds to describe the drawings of the plans of the building, as exhibited upon the walls of the room, shewing the original idea of the building and the improved design as it now stands.) The height of the centre aisle is 64 feet, the side aisles 44 feet, and the outside aisles or first-story 24 feet. The transept is 108 feet in height, and is covered with a semicircular roof, like that of the great conservatory at Chatsworth, in order to preserve the large elm trees opposite to Prince's gate. The whole number of cast iron columns is 3300, varying from 14 feet 6 inches to 20 feet in length. There are 2224 cast and wrought iron girders, with 1128 intermediate bearers, for supporting the floors of the galleries over the large openings of the aisles. The girders are of wrought iron, and those for the galleries are of cast iron. The fronts of the galleries are also supported by cast iron girders. The dimensions of the building are 1851 feet in length, and 456 feet in breadth in the widest part. It covers, altogether, more than 18 acres, and the whole is supported on cast iron pillars, united by bolts and nuts fixed to flanches turned perfectly true, and resting on concrete foundations. The total cubic contents of the building are 33,000,000 feet. The six longitudinal galleries, 24 feet in width, running the whole length of the building, and the four transverse ones, of the same dimensions, afford 25 per cent. additional exhibiting surface to that provided on the ground floor. This extra space is suited for the display of light manufactured goods, and will also give a complete view of the whole of the articles exhibited, together with an extensive

view of the interior of the building. In order to give the roof a light and graceful appearance, it is built on the ridge-and-furrow principle, and glazed with British sheet glass, as previously described. The rafters are continued in uninterrupted lines the whole length of the building. The transept portion, although covered by a semicircular roof, is also on the angular principle. All the roof and upright sashes being made by machinery, are put together and glazed with great rapidity,—for, being fitted and finished before they are brought to the place, little more is required on the spot than to place the finished materials in the positions intended for them. The length of sash-bar requisite is 205 miles. The quantity of glass required is about 900,000 feet, weighing upwards of 400 tons. All round the lower tier of the building, however, will be boarded with fillets planted on in a perpendicular line with the sash-bars above.

The gutters are arranged longitudinally and transversely: the rain-water passes from the longitudinal gutter into a transverse gutter over the girders, and is thus conveyed to the hollow columns, and thence to the drains below. As these transverse gutters are placed at every 24 feet apart, and as there is a fall in the longitudinal gutters both ways, the water has only to run a distance of 12 feet before it descends into the transverse gutters, which carry it off to the hollow columns or down-pipes. The grooves for carrying off the moisture which condenses on the inside of the glass are cut out of the solid; in fact, the whole gutter is formed by machinery at one cut. The gutter is cambered up by tension-rods, having screws fixed at the ends, so as to adjust to the greatest nicety, as is the case with the wrought iron girders which span the Victoria Lily House.

Many experiments were tried in order to find out the most suitable floors for the pathways of horticultural structures. Stone was objectionable, chiefly on account of the moisture and damp which it retained. The difficulty of getting rid of the waste from the watering of plants was also an objection; but perhaps the greatest was the amount of dust from sweeping. It likewise appeared that close boarding for pathways was open to many of the same objections as stone; for although damp and moisture was in part got rid of, yet still there were no means of immediately getting rid of dust. These various objections led the author to the adoption of trellised wooden pathways, with spaces between each board, through which, on sweeping, the dust at once disappears, and falls into the vacuity below. Whilst the accomplishment of this point is most important in plant-houses, it is doubly so with the industrial building, where there will be such an accumulation of various articles of delicate texture and workmanship. Before sweeping the floors, the whole will be sprinkled with water from a movable hand-engine, which will be immediately followed by a sweeping machine, consisting of many brooms fixed to an apparatus on light wheels, and drawn by a shaft. Thus a large portion of ground will be passed over very quickly. The boards for the floor will be 9 inches broad and 1½ inches thick, laid half an inch apart, on sleeper joists 9 inches deep and 3 inches thick, placed 4 feet apart. This method of flooring, then, possesses the following advantages:—It is very economical; dry, clean, pleasant to walk upon; admits of the dust falling through the spaces; and even when it requires to be thoroughly washed, the water at once disappears betwixt the openings, and the boards be-

come almost immediately fit for visiters. The galleries will be laid with close boarding.

The *ventilation of the building* has been most carefully considered, and a most copious supply of pure air is provided. Four feet round the whole of the basement part of the building is made of *louvre boarding;* and at the top of each tier a similar provision of 3 feet is made, with power to add an additional quantity if required. In the centre aisle, also, the air will be plentifully admitted.

By simple machinery the whole of this ventilation can be regulated with the greatest ease. The advantages of this kind of ventilation are several. Louvre boards are very simple in construction; they can be opened and closed instantaneously with the greatest readiness; they nicely distribute the air, and yet admit a large volume of it; and, from the manner in which they are placed over each other, they effectually prevent the entrance of wet in rainy weather.

In order to subdue the intense light, in so large a building covered with glass, all the south side of the upright parts, and the whole of the angled roof, will be covered outside with canvas or calico, so fixed as to allow a current of air to pass between the canvas and the roof. In very hot weather, water may be poured on, which will very much assist in cooling the temperature within. Provision will be made to use the Indian plan of ventilation, if the heat is so intense as to render it desirable to have the temperature cooler than out of doors. A house was fitted up last summer at Chatsworth, as an experimental place to try this mode of ventilating, when it was found to answer the purpose admirably. The temperature was reduced in one hour from 85° to 78°, without any other means being used to increase the draft through the building. This sort of covering offers the following advantages:—the brightness of the light will be tempered and subdued; the glass will be protected from the possibility of injury by hail; the screen being placed on the outside will render the building much cooler than if it were placed inside; and through this provision the ventilation can be regulated at pleasure. From the side galleries, running the whole length of the building, there will be grand views of the goods and visiters below; whilst the transverse galleries in the middle and at the ends will afford ample means for general supervision, and will serve to communicate between the side galleries. Magnifying glasses, working on swivels, placed at short distances, will give additional facility for commanding a more perfect general view of the Exhibition. After the Exhibition is over, the building might be converted into a permanent winter garden, and have carriage drives and equestrian promenades made through it. Pedestrians would have about two miles of galleries, and two miles of walks upon the ground floor, and sufficient room would then be left for plants. The whole intermediate spaces between the walks and drives could be planted with shrubs and climbers from temperate climates. In summer the upright glass might be removed, so as to give the appearance of a continuous park and garden. A structure where the industry of all nations is intended to be exhibited, should, it is presumed, present to parties from all nations a building for the exhibition of their arts and manufactures that, while it affords ample accommodation and convenience for the purposes intended, would, of itself, be the most singular and

peculiar feature of the exhibition: how far this has been accomplished, must be left to the community to decide. It will be seen that from the simplicity of the Exhibition building of 1851 in all its parts, together with the simplicity of the detail, its construction does not offer matter for much detail. The author, in conclusion, remarked, that structures of this kind are susceptible of the highest kind of ornamentation in stained glass and general painting; and that they may well be expected to come into almost universal use. This system of building, he said, is capable of application to manufacturing purposes, as well as general cemeteries; and even market-gardeners might advantageously employ it in the growing of foreign fruit for the London markets. In short, there is no limit to the uses to which it may be applied—no foresight can define the limits where it will end; and we may congratulate ourselves that in the 19th century, the progress of science and the spirit of manufacturers have placed at our disposal the application of materials which were unknown to the ancients, and thereby enabled us to erect such structures as would have been deemed impossible even in the early part of the present century.

Several questions were then put to Mr. Paxton with reference to the details of his plan, which he answered apparently to the satisfaction of the meeting.

Translated for the Journal of the Franklin Institute.

Latent Heat of Water.

In an article contained in the September number of the *Annales de Chimie et de Physique*, M. C. C. Person has pointed out a necessary correction of the determination of the quantity of heat which becomes latent in the melting of ice;—a correction which, although not very large, is yet interesting, and depends upon a somewhat curious fact. Dr. Black first determined the heat thus absorbed to be 80° Cent., (144° Fahr.) (That is, he determined that one pound of ice in melting, without change of temperature, would lower the temperature of 144 lbs. of water 1° Fahr.) But not much confidence was placed in the accuracy of his result. Wilke found 72, (129·6;) Lavoisier and Laplace 75, both of which numbers were in disaccordance with the calculation of phenomena. Finally, the very carefully conducted experiments of Provostaye and Desains, confirmed by those of Regnault, gave 79 (142·2) as the true result. It is this latter number which M. Person, admitting the entire accuracy of the experiments, proposes to correct. His objection is, that the whole heat absorbed by ice in melting cannot be determined by beginning the experiment at the temperature 0° (32° Fahr.) In fact, it is well known that in general, before any body melts, it becomes soft; and during this softening there is an absorption of heat. In some cases, as in wax, the quantity of heat thus absorbed exceeds that taken up in the actual melting. The experiments of Regnault themselves shew, that when the initial tempera-

ture of the ice was taken below 0°, (32° Fahr.,) the latent heat given was greater in proportion as this temperature was lower. Thus we have:

Initial temperature of the ice,	—0·06°	Latent heat of fusion,	79·17
" "	—0·32	" "	79·35
" "	—0·51	" "	79·50
" "	—0·61	" "	79·71

Thus at once demonstrating the accuracy of the experiments themselves, which are found to contain the expression of the unobserved law, and sustaining the objection of M. Person. We give the result of M. Person's experiments with a calorimeter which he describes, the accuracy of which is proved by his determinations with it of the specific heat of water and saline solutions—remarking only that the temperatures are all expressed in Centigrade degrees, and the weight in grammes:

M	T	T′	a	m	t	l	D
			cal.	gr.			
992·8	18·813	7·049	+ 5·0	132·24	— 2·94	79·90	11·0
982·0	14·720	4·012	—10·3	123·58	— 2·11	79·97	12·7
991·9	14·367	3·903	—17·5	121·33	— 3·27	79·93	12·2
991·8	16·554	4·823	—15·7	130·24	— 8·80	80·14	10·6
992·0	14·583	4·848	— 3·6	109·87	— 6·44	80·00	10·1
1068·0	16·846	4·932	—77·0	132·20	—21·10	80·14	90·0

M is the complete equivalent of the calorimeter in water.

T the temperature of the water in the calorimeter at the beginning of the experiment.

T′ the temperature of the water in the calorimeter at the end of the experiment.

a the quantity of heat which entered the calorimeter during the experiment.

t the initial temperature of the ice.

l the quantity of heat absorbed by the ice in melting, expressed by the weight of water, of which this heat would raise the temperature one degree Centigrade.

D the duration of the experiment in minutes.

The latent heat of water at 0° (32°) may then be taken at 80 (144 Fahr.) By two experiments with the same apparatus the specific heat of ice was found to be 0·48. F.

For the Journal of the Franklin Institute.

A Series of Lectures on the Telegraph, delivered before the Franklin Institute. By Dr. L. Turnbull. 1850–51.

The term Telegraph is derived from the two Greek words Τωι (Tele) and Γραφω (Grapho), meaning "I write afar off." It is the name given to any mechanical contrivance for the rapid communication of intelligence by signals. Of late years the term semaphore (from Sema, (Σημα,) a sign,

and Phero, (φερω,) I bear,) has been introduced by the French, and frequently adopted by English writers.

Although the art of conveying intelligence by signals was practised in the earliest ages, and was known even to the rudest savages; and though its importance is not only obvious, but continually felt, wherever government is established, it has been allowed to remain in its original state of imperfection down almost to the present day. The first notice of any method of this kind of communication is to be found in the 6th chapter and 1st verse of the prophet Jeremiah. He says, "O, ye children of Benjamin, gather yourselves to flee out of the midst of Jerusalem; blow the trumpet in Tekoa, and set a *sign* of *fire* in Beth-heccerem.

The proposed object of the telegraphic art is to obtain a figurative language, the characters of which may be distinguished at a distance. Barbarous nations employed torches, fires on the tops of distant hills, hoisting of flags, carrier pigeons, drums, speaking trumpets, &c. More recently, since the invention of gunpowder, cannons and sky-rockets have been applied to the same use.

The first description of a telegraph universally applicable, was given by Dr. Hooke, in the *Philosophical Transactions* for 1684. The method which he proposed, (for it was not carried into effect,) consisted in preparing as many different shaped figures, formed of deal, as, for example, squares, triangles, circles, &c., as there are letters in the alphabet. He exhibited them successively, in the required order, from behind a screen, and proposed that torches or other lights, combined in different arrangements, should supply their place by night.

About twenty years later, Amontons, of Paris, exhibited some experiments before the royal family of France and the members of the Academy of Sciences, by which the practicability of the art was demonstrated. It was not until 1794 that these experiments were applied to any useful purpose, when the plan was adopted for conveying intelligence to the French armies.

The first telegraph actually used was the invention of Chappe. It consisted of a beam, which turned on a pivot in the top of an upright post, having a movable arm at each of its extremities; and each different position in which the beam and its two arms could be placed at angles of 45°, afforded a separate signal which might represent a letter of the alphabet, or have some other signification that might be agreed upon.

In the following year, 1795, several plans were submitted to the English Admiralty, of which, one proposed by Lord George Murray was adopted, and continued to be made use of down to the year 1816. It consisted of six shutters arranged in two frames, which being opened and shut according to all the different combinations which can be formed, afforded the means of giving sixty-three separate and distinct signals.

In 1803, the French erected semaphores along their whole line of coast, formed of upright posts, bearing two, or sometimes three, beams of wood, each turning on its own pivot, one above the other.

In 1807, Captain Pasley, of the Royal Engineers, published his Polygrammatic Telegraph, differing from the French semaphore by having beams turning on the same pivot; and, in order to obtain a sufficient num-

ber of different signals, he proposed to erect two or three posts at each station.

In 1816, Sir Home Popham considerably simplified this construction. His telegraph consists of merely two arms, movable on different pivots, on the same mast, as seen in the annexed figure.

Lastly, in 1822 General Pasley still farther simplified its construction, by placing the two arms on the same axis. For day signals, the telegraph consists of an upright post of sufficient height, with the two arms movable on the same pivot on the top of it, and a short arm called the indicator, on one side; as seen in the annexed figure. Each arm can exhibit the seven positions 1, 2, 3, 4, 5, 6, 7, besides the position called the *stop*, which points vertically downwards, and is hid by the post. The use of the indicator is to show the order or direction in which the signals are to be reckoned. In order to adapt the telegraph to the purpose of making night signals, a lantern, called the central light, is fixed to the pivot on which the arms move, and one is also attached to the extremity of each arm. A fourth lantern is also placed on the extremity of the indicator. Motion is communicated to these arms by means of an endless chain passing over two pullies; one fixed to the arm itself, and turning on the same pivot, and the other on a pivot fixed to the lower part of the post, within the reach of the signal-man. The required positions are pointed out by a dial plate, the index of which is moved by a lever attached to the lower pulley.

In the Report on Telegraphs for the United States, made at the request of the Hon. Levi Woodbury, Secretary of the Treasury, by the Committee on Science and the Arts of the Franklin Institute, the Committee say:—

"We are disposed to recommend a much more simple instrument, nearly similar to one lately introduced by M. Chateau, in a line of telegraphs which the Russian government is erecting between Petersburgh and Warsaw, and which is described in a late number of the *Petersburgh Transactions*, by M. Parrot, together with a scheme of his own, almost identical with it, on which he had made successful experiments many years before.

"This proposed telegraph consists of a single arm, or *indicator*, which should be about nine feet long and one foot wide, with a cross-piece at one end, about three feet long and one wide; the whole arm being movable about an axis at its centre. The arms are formed like Venetian shutters, and are painted a dead black; the apparatus and fixtures about it being white.

"The movements may be communicated with ease and certainty, either by an endless chain passing over a wheel on the axis, and a wheel in the building; or by bevel wheels on the axis, and on a vertical bar passing from the building; or by a cog-wheel on the axis, and an endless screw on a vertical bar.

"For night signals, three lamps are used; one swinging beyond the end of the arm, the other two beyond the ends of the cross-piece."

Every system of telegraphic signals, according to this plan, is of necessity accompanied with a telegraphic dictionary, containing the meaning of the different combinations of signs. They were defective, from inability to communicate all kinds of information, uncertainty in practice, a want of simplicity in operation, were too slow in conveying intelligence, and afforded no means for secresy in correspondence. The rapidity with which electricity traverses great lengths of conducting matter, coupled

with the power which it possesses of deflecting electrometers, had at an early period led to the idea of employing it as a means of conveying signals from place to place; and this system has, within the last few years, been brought to such a degree of perfection, as to render it more than probable, that ere long it will supersede all other modes of conveying intelligence, not merely for telegraphic purposes, but also for many other similar and not less important uses. *Solle's Lec. on Tel.*) The peculiar properties of electricity upon which the action of the telegraph depends, are its passage along conducting bodies, the power to render iron a temporary magnet, its capability to decompose chemical combinations, and cause deflection of the galvanometer needle. An electric telegraph is an instrument or apparatus which, by means of conductors of iron, copper, soil, or water, conveys intelligence to any given distance with the velocity of lightning.

Previous to the publication of any inventions for this purpose, a number of experiments had been made as to the transmission of electricity through considerable length of iron wire, water, and even soil.

In 1729, Mr. Grey and Mr. Wheeler observed the instantaneous discharge of electricity through some hundreds of feet of wire.

In 1746, Winckler, at Leipsig, and Nollet and Lemonnier, at Paris, made numerous experiments on the transmission of electricity through water, earth, &c.; in one case, wires of more than two miles in length were employed, (*Philosophical Transactions*, 1746.)

In July, 1747, Dr. Watson, Bishop of Llandaff, together with several other electricians, ascertained the passage of electricity through water, by sending shocks across the Thames; experiments which they subsequently repeated on a still larger scale through the New River, at Newington; and in August, 1747, they transmitted shocks through two miles of wire, and two miles of earth at Shooter's Hill. The passage of electricity through water excited a great deal of interest, and these experiments were repeated in 1748, by Franklin, across the Schuylkill, at Philadelphia; and in 1749, by De Luc, across the Lake of Geneva.

Though electricity is the agent used in common by all telegraph operators, its mode of application has been as manifold as the number of laborers in this most interesting combination of science and art. Those now in use, and before described by historians, can be included in three divisions;—taking them in the order of discovery and application, we have first the electric, in which simple frictional electricity was alone used; next the galvanic, where voltaic electricity was employed; and last, the electro-magnetic, combining the agencies of electricity and magnetism. The first was used during the period from 1745 to 1800; the second from 1800 to 1825, the third from 1825 to the present time. From 1820 to 1850, there have been no less than sixty-three claimants for different varieties of telegraph.

The first electric telegraph appears to have been made about the year 1786; though long before that time the vague idea of a magical magnetic telegraph appears to have been entertained, for the Roman Jesuit Strada, who lived from 1572 to 1649, in a curious book, dated 1617, entitled *Prolusions*, describes a fabled contrivance of two magnetic needles, attached to dials, bearing a circle of letters, and which possessed the pro-

perty of always indicating the same letter, so that when one needle was made to point to any particular letter, the other needle, however distant at the time, placed itself so as to point to the same letter. An account of this curious idea will be found in the *Spectator*, 241, and *Guardian*, 119.

The first real attempt which seems to have been made to render electricity available for the transmission of signals, is described by Moigno, in his *Traité de Telegraphie Electrique.* It is that of Lesage, a scientific Frenchman, who in 1774 established an electric telegraph at Geneva, composed of 24 metallic wires, separated from each other, and immersed in a non-conducting matter. Every wire corresponded with a particular electrometer, formed of a small ball of elder, suspended by a wire. By placing an electrical machine in communication with either of these wires, the ball of the electrometer which corresponded to it was repulsed, and the movement designated the letter of the alphabet, or whatever conventional signal it was wished to transmit.

In the 1st volume, page 42, of Arthur Young's *Travels in France* during the year 1757, will be found the following description of an electric telegraph:

"Mr. Lomond has made a remarkable discovery in electricity. You write two or three words upon paper; he takes them with him into a chamber, and turns a machine in a cylinder case, on the top of which is an electrometer, having a pretty little ball of pith of a quill suspended by a silk thread; a brass wire connects it to a similar cylinder and electrometer in a distant apartment, and his wife, on observing the movements of the corresponding ball, wrote the words which it indicated. From this it appears that he had made an alphabet of movements; and as the length of the brass wire made no difference, you could correspond at a great distance, as for example, with a besieged city, or for purposes of more importance."

Electricity was generated and retained by the common machine and a Leyden phial. Having but one movement, and using an apparatus extremely delicate, we must suppose this mode of communication to be limited and dilatory.

In *Voigt's Magazine* for 1794, Vol. IX., p. 183, there is a letter from Reusser, of Geneva, in which he describes an electric telegraph. In this contrivance, a number of strips of tin foil were fastened on a glass plate, each strip having a different letter marked on it, and connected by carefully insulated wires inclosed in glass tubes, with a corresponding glass plate at a distance. Thus there was a separate wire for each letter, and one return wire for the whole series. Signals were transmitted by sending electric shocks through the different wires, and noting down the letters attached to the strips of tin-foil, where the sparks were observed. The attention of the observer at a distant station was drawn by firing an inflammable air pistol attached to the apparatus, by means of an electric spark.

"A similar and yet more practical proposition was soon after made by Professor Boeckman. He proposed to choose as the signals the sparks passing at the distant station, using only two wires, by which first one and then, after certain intervals, more sparks being combinedly grouped," indicating the particular letter, so as to get rid of the large number of wires used by Reiszer, and also the twenty-six glass plates; in the same manner as the alarms of fire are indicated by our State House clock.—(*Dr. H. Schellen's Electro-Magnetic Telegraph, p.* 46, 1850.)

The *Madrid Gazette* of November 25th, 1796, states, that the Prince de la Paix, having heard that M. D. F. Salva had read to the Academy of Sciences, a memoir upon the application of electricity to telegraphing, and presented at the same time an electric telegraph of his own invention, desired to examine it; when, being delighted with the promptness and facility with which it worked, presented it before the king and court, operating it himself. After these experiments, the Infanta Don Antonio desired another more complete telegraph, and occupied himself in testing the quantity of electricity that would be required by the telegraph at different distances, whether on land or water.

Some useful trials were made and published in *Voigt's Magazine*. Two years after, the Infanta Don Antonio constructed a telegraph of great extent on a large scale, by which the young prince was informed at night of news in which he was much interested. He also invited and entertained Salva at court. According to Humboldt, a telegraph of this description was established in 1798, from Madrid to Aranjuez, a distance of 26 miles. Other writers affirm, that M. Betancourt established a line of telegraph between the same places in 1787, and worked it with frictional electricity.

M. Cavallo published some experiments which he had made on the transmission of signals in 1795. (4th edition, *Traité de Electricitie*, published 1798, vol. III., page 285.) The most important of these consisted in firing gunpowder, phosphorus, and hydrogen, by electric sparks, at a distance of a few hundred feet. He adds, that the same might be done at the distance of many miles.

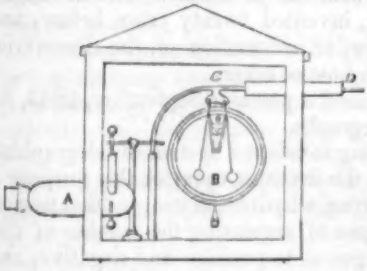

Fig. 1.

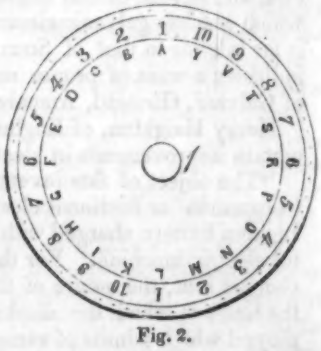

Fig. 2.

The next electric telegraph in order of dates, was that of Mr. Francis Ronalds, who in 1816 constructed one, by means of which he was enabled to send signals with considerable facility and rapidity, through a distance of eight miles, using frictional electricity. He published a work in 1823, describing his telegraph, and illustrating it with plates; also, several other electrical instruments of his invention. This plan was very simple; at either end of the wires was a clock, carrying a light paper disk, on which were marked the letters of the alphabet, and certain words and numbers. By means of a perforated cover, only one letter and figure were visible at a time, and, as the clock continued to go, every letter in turn was presented at the aperture to the view. As the clocks kept accu-

rate time, it is evident that the same letter would always be visible at both clocks, and therefore that if an electric discharge were sent from one station to another, when a particular letter was exhibited on the dial, the observer at the other station would readily know the signal intended. The wires were buried under ground, in dry and well insulated glass tubes. The attention of the observer was, at the outset, drawn to the instrument by an inflammable air gun fired by an electric spark, and the subsequent signals indicated by the divergence of two small pith balls suspended in front of the revolving disks, a distance of eight miles along a wire.

Fig. 1 shows the form of the apparatus used at either end of the telegraph. A, the air pistol; B, the dial, exhibiting one letter only through a slit; C, pith ball electrometer; D, conducting wire. Fig. 2, the dial without the slit, showing the letters and numbers upon it.

Harrison Grey Dyer, an American, constructed a telegraph in 1827–8 at the race course on Long Island, and supported his wires by glass insulators fixed on trees and poles. By means of common electricity, acting upon litmus paper, he produced a red mark, and then passed the current through the ground as a return circuit. The difference of time between the sparks indicated different letters arranged in an arbitrary alphabet, and the paper was moved by the hand.—(*Bell's Evidence in House's Case.*)

Like many preceding it, this instrument appears to have been little more than a philosophical toy,—frictional electricity being too easily dissipated, rapid and incontinuous in action, confined with great difficulty to conductors, and devoid of that dense, energetic, yet almost imperceptible, force which renders galvanic electricity so available in this art. His instrument is far inferior to that of Sœmmering, invented twenty years before, and indicates a want of proper regard for, or information of, the discoveries of Galvani, Œrstead, Ampere, and a host of others.

Henry Haighton, of England, secured a patent in September, 1844, for certain improvements in electric telegraphs.

"The object of this invention being to adapt a system of telegraphing to common or frictional electricity, the inventor uses for this purpose a Leyden battery charged with Armstrong's hydro-electric, or other powerful electric machine. For the purpose of regulating the number of discharges sent, the nature of the charges as to positive and negative, and the times at which the discharges are transmitted, an instrument is employed which admits of various modifications according to circumstances. By this invention, it can be shown that, in ten discharges, any signal out of a number of sixteen thousand may be made; and by thirty discharges, any one of more than a thousand millions.

"The method of reading the signals at the terminal point is by means of two wires, one communicating with the point of transmission, and the other with the earth; they are placed at right angles to a sheet of paper which is moved along by machinery, so that each discharge may traverse the surface, and penetrate the substance of the paper close to the wire giving out the negative fluid. The paper is colored with chromate of lead, and moistened with sulphuric acid, to expedite the passage of the spark; and by this means the sparks leave upon the paper a register of the signals that have been made."—*Lond. Mech. Mag., Vol.* XLII., *p.* 122.

To be Continued.

Preparation of Spongy Metallic Lead, and its Application to Galvano Plastics. By Professor Bolley.*

The following is the method which Professor Bolley adopts for preparing sheets of lead:—He coats, as uniformly as possible, and to a thickness of from 2 to 3 centimetres, an even plate of zinc, with a thick paste of sulphate of lead ground with water. This plate of zinc is laid upon a dish, filled with a (not quite saturated) solution of marine salt, in such manner that the plate may only dip in the upper portion of the solution, but yet sufficiently deep to be entirely covered thereby. Upon this paste of sulphate of lead is ordinarily laid another thin sheet of zinc. By operating in this manner it would appear that the operation is most effectually accelerated, and that the salts formed, instead of remaining in the lead, fall to the bottom of the solution. At the expiration of three days (which period is, however, sometimes extended to eight or ten) the mass, which is from 2 to 3 centimetres in thickness, is completely transformed into metallic lead. This mass, still saturated with the solution of marine salt, and lying upon the plate of zinc, is now placed in a vessel full of hot water in order to extract the salts, and the lead which remains constitutes a soft coherent mass, capable of receiving a permanent impression, even from the finger, and presenting metallic lustre when but lightly rubbed with a hard polished body.

On being submitted to the action of a powerful press, this mass is transformed into a solid sheet of elastic lead; or it may be made to take any desired form with the greatest nicety, on being compressed into moulds or on to models.

This latter property led M. Bolley to make some experiments with the view of applying this substance to galvano-plastics. He obtained from it, by means of pressure, copies of seals, coins, &c.; and these answered perfectly well the purpose of matrices for galvanic precipitation, after being gilt or silvered; but whether from want of time or patience, or of a sufficiently powerful press, M. Bolley could not succeed in obtaining good deposits of copper upon the leaden moulds. The reason of this is, that the copper enters the pores of the lead, and it is only by applying very powerful pressure to the lead, or perhaps by coating it with silver, and thereby stopping up the pores, that the infiltration of the copper could be entirely prevented. From the same cause, when it is required to remove the metallic deposits, the leaden model is always sacrificed, as there will always remain adherent particles of copper, which can only be removed by acetic acid.

Variation in the Melting Point of Ice.†

Mr. James Thompson, of Glasgow, and his brother professor, Wm. Thompson, have shown that water, and all bodies which expand in solidifying, liquify or solidify at a lower temperature as the pressure is greater. For water, if we call t the Fahr. degrees of temperature below

* From the London Journal of Arts and Sciences, for November, 1850.

† From the London Railway Magazine, No. 602.

32° at which water freezes or ice melts, and n the number of atmospheres added to the common atmospheric pressure, they give us the following equation :—

$$t = \cdot 0135n.$$

According to this it would take 74 additional atmospheres of pressure, or about half a ton weight, or a pressure equal to a depth in water of 2200 feet (going on for half a mile) to lower the temperature of water freezing one degree Fahr.

We insert the above for the purpose of appending Prof. Cresson's ingenious speculations on the effects of this law,—supposing it to be proved to be a law, which we must confess does not appear to us at all to result from Prof. Thompson's experiment. F.

Prof. Cresson made some remarks upon the experiments of Prof. Thompson, of which an account is given in a recent number of the *London and Edinburgh Philosophical Magazine*, and which Prof. T. believes to show that the temperature of congelation of water and other bodies that expand at the moment of solidification, is raised proportionally to the increase of pressure to which they are subjected, the ratio of temperature to pressure being for water $\frac{1}{10}$th of a degree of Fahr. scale for 10 additional atmospheric pressures.

Mr. C. presented to the notice of the Society a speculation into which he had been led on the subject, showing the effect that such a law might produce in causing water to retain the state of a solid at a very high temperature. For example, if a continuous channel, admitting atmospheric communication, should exist in the crust of the earth to the depth of seventy miles, the pressure of the atmospheric column would exceed fifteen million pounds on the square inch, and according to Prof. T. water should remain solid at a temperature above 10,000° Fahr., a heat far above that of molten iron.—*Proc. Am. Phil. Soc., Nov.* 15, 1850.

Specification of the Patent granted to Gustave Eugene Michel Gerard, *of Paris, in the Republic of France, for Improvements in Dissolving Caoutchouc (India Rubber) and Gutta Percha.*—Sealed May 7, and enrolled October 7, 1850.*

The invention consists in certain means of dissolving India rubber. Heretofore all solutions of India rubber, whether clear or thick, have preserved a great coherence and elasticity; the solvent, whatever it may have been, has always expanded very largely the gum, and it is not until after this has taken place with the gum that the real act of dissolving the gum commences: for this reason a large quantity of the solvent is required. To endeavor to remedy these inconveniences, and to have the solution of a thick substance, the India rubber has been heretofore expanded in the solvent, and pressed afterwards, by means of cylinders; the solution obtained by this process preserves a very great cohesion and elasticity. By the process to be afterwards described, I obtain caoutchouc or gutta percha, or the two combined in a state of solution as thick and

* From the London Repertory of Patent Inventions, for December, 1850.

concentrated as may be required: and further, however thick it may be, yet it loses its tenacity and elasticity, and will assume the form of paste after the evaporation of the solvent, and retake all its former properties. My process consists in mixing with the solvent, of whatever nature it may be, a certain quantity of alcohol, and afterwards to macerate the caoutchouc or gutta percha; they will expand a very little, and at the end of twenty hours it will become in the state of paste, and may be moulded into any required form. I prefer to employ as a solvent sulphuret of carbon and chloroform, sulphuric ether, naphtha, essential oils of coal, or turpentine, and to which I add from five to fifty per cent. of alcohol. I then mix the caoutchouc in all proportions, from equal parts up to thirty parts of the alcoholized solvents to one part of the caoutchouc, according to the thickness of the solution required; after one or two days I submit the paste to the process of masticating, according to the ordinary plan, if I would have an equal solution, and in case when it is made with small quantities of the solvents. In the contrary case, the heating becomes altogether useless. I adopt the same system when heating gutta percha, and by these means completely purify it. I then dissolve it in the alcoholized sulphuret of carbon, and dilute it until it arrives at the state of thick syrup of sugar, and leave it to remain in that state for three or four days. The impurities will deposit themselves or swim on the surface. I draw off the centre part, which gives the gutta percha in a state of complete purity. Thus it will be seen that the character of the invention is the mixture of alcohol with the solvent used for dissolving caoutchouc. Alcohol, as is well known, being the liquid which precipitates most quickly India rubber from its solutions; it is this property of the alcohol which I have applied to this purpose. In causing the alcohol, by means of a solvent, to enter into the interior parts of the caoutchouc, or to better express it, I detach all the adherent atoms which form the mass of the caoutchouc, as will be easily seen in a clean solution, to which is added the alcohol; these particles become less adherent among themselves, and are easily separated by pressure, which can be given, preferring always the form resulting from this pressure, and not returning, as with the caoutchouc, to their ordinary form. The solvent and the alcohol being evaporated, the rubber will return to its original state. The alcohol I prefer to employ to mix with the solvents, such as spirit of wood, oil of potato, and all liquids which possess the properties of alcohol; but it would be difficult to define all the liquids which would act according to my invention for the purpose of precipitating the caoutchouc for its solutions. I should comprise all liquids which have not the property of dissolving the India rubber, and which can be introduced into the gum by means of a solvent. I have, therefore, only indicated those which experience has proved to be successful, but I wish it to be understood that the principle of my invention is, the causing matters which are not of a solvent nature to be introduced into the body of the rubber by means of a solvent, and having the property to disunite the parts constituting the mass of rubber and destroy the adherence of the particles, whether these matters are combined with the solvents or introduced by themselves.

*The Copying Electric Telegraph.**

The working of the machine is as follows:—The message is written with sealing-wax varnish on tin foil, and then applied to the transmitting instrument, which consists of a cylinder, on which a point presses, that point being in connexion with the voltaic battery. The receiving instrument at the other end has a cylinder and point exactly corresponding with that of the transmitting one. On the receiving instrument, a slip of paper, moistened with muriatic acid and prussiate of potash, is placed, and on which a point presses as on the transmitting instrument. The point of the receiving instrument consists of steel wire. When the electric current passes through both instruments, a mark is made on the paper by the decomposition of the muriatic acid, and a deposition of iron takes place on the paper. When the instruments are in action, the point of the transmitting instrument, by passing over the varnish writing, comes in contact with the voltaic battery. At the parts where the varnish writing occurs, the circuit is interrupted, and a blank is left on the receiving instrument; but when it rests on the tin foil, a blue mark is left. As the point passes over each line of writing in different parts, the whole letters are formed by a succession of lines. It is stated by Mr. Bakewell, that it is essential to the completeness of this process that the two instruments should move exactly together, and this desideratum is secured by the regulating power of an electric magnet.—*Morning Chronicle.*

There seems to be some doubt in England as to the true inventor of this telegraph. We can only say that we have had in our possession for two years, a working model of a telegraph answering exactly this description, and invented by Mr. Bain. In model the apparatus works perfectly well; but we are not aware that it has ever been practically applied on an extended scale. Ed.

Universal Meridian.†

I have been much interested lately by what has appeared in the French journals, and been referred to in your columns, relative to a proposal for the establishment of a Universal Meridian.

The desirableness of such an object will no doubt be admitted by all. The difficulty of carrying it out seems to arise from the mutual jealousy of various governments. While considering the subject, the following thoughts have crossed my mind in connexion with it:

Would it not be desirable to fix the new first meridian in that part of the world where travelers have to change their reckoning? This change takes place, as we learn from Simpson's *Voyage round the World*, in passing from the British to the Russian settlements in Northwestern America, in or about longitude 130° W. Thus, when the Russians are celebrating their Sabbath, the British close at hand are yet laboring on their Saturday. For, the former, having traveled eastward against the sun's

* From the London Railway Magazine, No. 601.

† From the London Athenæum, December, 1850.

course, have gained in time,—and the British, going westward, have lost. The earliest commencement, therefore, of any given day is with the Russians in Northwestern America,—and the latest with the British in the same quarter of the world.

Thus, suppose it was agreed that at the first moment of next Christmas day—*i. e.* as soon as the clock had struck twelve on the night of December 24th—a gun should be fired at every government station,—this gun would be fired first by the Russians to the west of longitude 130° W., when it would be about noon of December 24th, N. S., at Moscow, about 8 A. M. of the same day in Britain, about 3 A. M. at Washington, and the beginning of December 24th in Vancouver's Island,—where, accordingly, the gun would not be fired till twenty-four hours had elapsed from the time of its being fired by the Russians close at hand.

Again, would there not be less risk of confusion if the present method of reckoning longitude, both east and west, were given up, and in future all longitudes were marked as *west only* from the universal meridian fixed as above, where the day is first reckoned? According to this plan, if Queen Charlotte's or Pitcairn's Island were fixed on for the first meridian, Yarmouth Roads would be marked as in longitude 225°,—*i. e.* west, of course, and fifteen hours later in time.

If, however, it should be thought better not to give up the distinctions of east and west longitude, and to retain the universal meridian in the Old World, there is one spot which suggests itself as very appropriate, both from its associations, and as being also just opposite to that meridian where the change of reckoning is experienced. It is Jerusalem. The meridian of Jerusalem would surely excite as little jealousy as possible. At any rate, all Christians and Jews would agree, doubtless, to use it. I am not aware with whom the settlement of such a question lies; but the subject would surely be most appropriately discussed at the time of the Great Exhibition next year, when so many learned men will be collected from all parts of the world. If any decision should be arrived at, there might follow from it a scheme for establishing on some point of that meridian an "Observatory of all Nations," on a large scale, and supported by various governments—a spot sacred to science, declared to be inviolate by mutual agreement, and thus secured from the fears of war.

I am, &c., E. M. J. B.

The best first meridian would, in our opinion, be that of the Cape of Good Hope, because—

1st, It is the location of an excellent observatory, well situated for observing, and already celebrated for its results.

2d, The meridian passes through Europe near the most important observatories of the world, by means of which corresponding observations would be easily and accurately obtained.

3d, It passes for a very great part of its length over land, and cuts the ocean only at the Cape of Good Hope, which is the point of division between the two great oceans. Hence the Atlantic navigator is not required to change the denomination of his longitude, (if it be not agreed upon to reckon around the whole circle,) and although this be necessary in the voyages to China or India, yet it takes place at a point where ships go near to the land, and can easily take a new departure. It is true,

that in our present method of reckoning, the meridian will cut the Pacific Ocean; but this difficulty is common to all possible meridians, which do not commit the greater error of cutting the Atlantic, and can only be avoided by reckoning longitude, as it ought to be reckoned, from 0° by the east through 360°. ED.

The First Idea of the Electric Telegraph. By N. S. HEINEKEN.*

In the number of the *Philosophical Magazine* for May, I observe that Professor Maunoir claims for his friend Dr. Odier the first idea of the electric telegraph. I herewith send you a translation from a German work by Schwenter, entitled *Deliciæ Phyisco-Mathematicæ*, and published in 1636, from which it will appear that the *crude* idea of the electric telegraph was entertained upwards of a century before the period alluded to by Professor Maunoir. Indeed, Œrsted's grand discovery was alone wanting to perfect the telegraph in 1636. The idea, in fact, appears to have been entertained prior even to this date, for Schwenter himself quotes from a *previous* author.

Sidmouth, Nov. 12, 1850.

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"How two People might Communicate with each other at a Distance by means of the Magnetic Needle.

"If Claudius were at Paris and Johannes at Rome, and one wished to convey some information to the other, each must be provided with a magnetic needle, so strongly touched with the magnet that it may be able to move the other from Rome to Paris. Now suppose that Johannes and Claudius had each a compass divided into an alphabet according to the number of the letters, and always communicated with each other at six o'clock in the evening; then (after the needle had turned round 3½ times from the sign which Claudius had given to Johannes) if Claudius wished to say to Johannes, 'Come to me,' he might make his needle stand still, or move till it came to *c*, then to *o*, then to *m*, and so forth. If now the needle of Johannes' compass moved at the same time to the same letters, he could easily write down the words of Claudius and understand his meaning. This is a pretty invention; but I do not believe a magnet of such power could be found in the world."

Quoted from "*the Author*" by Schwenter, in his *Deliciæ Physico-Mathematicæ*, p. 346. 1636.

New Method of Producing Plates for Printing Ferns, Sea Weeds, &c. By FERGUSON BRANSON, M. D.†

A piece of gutta percha, free from blemish, and the size of the plate required, is placed in boiling water;—when thoroughly softened, it is to be taken out and laid flat upon a smooth metal plate, and immediately dusted over with the finest bronze powder used for printing gold letters.

* From the London, Edinburgh, and Dublin Philosophical Magazine, for December, 1850.
† From the London Athenæum, December 21, 1850.

The object of this is threefold :—to dry the surface,—to render the surface more smooth,—and to prevent adhesion. The plant is then to be neatly laid out upon the bronze surface, and covered with a polished metal plate, either of copper or of German silver. The whole is then to be subjected to an amount of pressure sufficient to imbed the upper plate in the gutta percha. When the gutta percha is cold, the metal plate may be removed, and the fern gently withdrawn from its bed. From the beautiful impression of the fern left in the gutta percha, a cast in brass may be readily taken. As soon as the surface of the brass cast has been burnished—of course, carefully avoiding the impression—it is ready for the copper-plate printer. If the printer skilfully mixes the ink to the tint of the fern, a print is obtained scarcely to be distinguished from the plant itself. The novelty of the process consists in causing the plant, so to speak, to engrave itself—and also in the substitution of a cheap casting in brass for an expensive copper-plate engraving. Electrotype plates may be deposited on the bronzed gutta percha, and a similar result obtained; but I have found the brass casting to answer equally well, and it has the advantage of being more durable, cheaper, and more expeditious. I send for your inspection several prints of ferns produced by this process.

Sheffield, December 18, 1850.

An Account of the Photometric Process adopted by M. Pernot, *Director of the Grenelle Gas Works, at Paris.**

The ordinary mode is, by throwing the reflection of each light on an opaque screen, bringing them to the same degree of intensity, and then by comparing the respective foci calculating the power of each light. M. Pernot throws the two lights on a transparent screen, and the observer standing behind, lights the reflections with a third light. If the two lights are equal, they disappear at the same time; if not, one of them remains. He likewise employs machinery, so as to move the lights on trial to arrange the foci.

Verdict of the Jury in the Case of the Boiler Explosion at Halifax.†

The trial of Samuel Firth, one of the proprietors of the Lily lane Mill, Halifax, and Joseph Helliwell, the engine tenter, for the manslaughter of 12 persons, through the explosion of a steam engine boiler, will not take place until the spring assizes at York. The two prisoners have been admitted to bail—each in 200*l*., with four sureties of 100*l*. each. As the result of the coroner's inquest, as well as the alleged cause of the explosion, is of considerable interest, we append a copy of the verdict of the jury:—"We find the explosion to have resulted from the improper and excessive generation of steam in the boiler, which, from the imperfect condition of the cotter and lug of one of the cross stays, along with other serious defects,

* From the London Architect, for December, 1850.

†From the London Mining Journal, No. 801.

was at the time in a very unsafe state, arising from the culpable negligence and want of attention on the part of Samuel Firth and Joseph Halliwell; against both of whom we return a verdict of manslaughter." The jury appended to their verdict the following very excellent suggestions:—"The jury deprecate the plan of erecting buildings over boilers. We also recommend very strongly the general adoption of safety valves on each boiler, on a construction which is best suited for the welfare and security of all persons connected with mills and machinery; and to impress upon all mill owners the necessity of employing properly qualified persons as engine tenters."

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*On the Economical Application of the Waste Gases from Blast Furnaces.**

In reference to Mr. Hu. L. Damsel's letter, published in last week's Journal, it appears singular that so trifling a decrease in the top of the furnace, caused by the iron cylinder, should be sufficient to account either for the scaffolding or decreased make of iron. We well know that a furnace will suddenly alter in its working and driving without any apparent cause, and such changes may be more owing to the chemical combinations going forward amongst the materials than to any alteration in their mechanical arrangement. A few degrees of heat, more or less, must very seriously interfere with the chemical operations going on in the body of the furnace; and it is very probable these changes and combinations in themselves both create and absorb heat, and, therefore, any interference or irregularity in the process must be very important to the proper working of the furnace. The first chemical action upon the ore, or mine, after it is charged in the furnace, is the converting of the *solid* oxygen into a *gaseous* compound, which would infer the abstraction of a vast amount of active heat, cooling the upper region of the furnace, and preventing the more fusible materials melting and running amongst the interstices of the coke, and ultimately causing the scaffolding and general derangement of the whole process. The melted ironstone, whenever this evil occurs, as it descends into the body of the furnace, or great laboratory, parts with its oxygen, and becoming thereby less or quite infusible, and cementing the mass of materials together, forms the scaffolding alluded to. As the materials beneath are consumed by the blast, a hollow space is left, and the direct action of the heat either melts the scaffold, or arch, or the weight of the superincumbent load breaks it down, causing what are called slips. While this is going forward, the chemical action, and its consequent combinations, is destroyed. The blast acts upon the general body of materials in the lower part of the furnace, which are usually protected by the cushion of carbon in the hearth on which they rest. A black cinder, or glass of iron, is the result, and the whole arrangement completely destroyed. In some cases this cinder might be used over again with advantage, as it frequently contains a great per centage of iron. Should, however, the cylinder, as at present used, induce these evils, it might be made the present full size of the furnace, and a space all round, at least 8 inches, be taken out of the lining for collecting the gas. A less space than

*From the London Mining Journal, No. 801.

this would restrict the supply of gas to the boiler, &c.; the lining round the top of the furnace would still be sufficiently strong.

When a furnace suddenly reduces its make from 150 to 120 tons of iron per week, it may arise from one of two causes; the burthen may be reduced, giving a larger proportion of coal, or less blast be driven into the furnace. In the latter case no scaffolding or general derangement would follow, and it does not appear that this, therefore, is the cause. On the contrary, it is very probable that the abstracting or drawing out of the gases causes *more air, or blast, to enter the furnace*, and this may render necessary such an alteration of the burthen as will account for the reduced make. If a furnace were driving at its full speed and make, any increase in the quantity of the blast would, especially in the old Welsh antiquated furnaces, with large flat boshes, pass undecomposed above the cushion of carbon, and act upon the iron-making materials, which are awaiting the time when they will reach the melting region—viz.: the bottom of the boshes, and run through the unmixed fuel into the hearth. No furnace can work properly unless all the blast is thoroughly and completely decomposed before it reaches and mixes with the iron ore, and for this reason it is absolutely necessary to have such a body of fuel about the tuyeres as will absorb the whole of the oxygen, and thus protect the ironstone. It is also essential that this should be done *in the hearth*, for the temperature in the boshes, for the extra size of that part of the furnace, would be too low to melt the iron. Instead, therefore, of adding more fuel, and reducing the make, it would be more desirable to reduce the quantity of blast, which could be done by lessening the size of the tuyere nozzles, till the proper quantity is ascertained for producing the maximum effect.

December 24, 1850. S. W. S.

For the Journal of the Franklin Institute.

Explosion of the Steamer "Knoxville," at New Orleans.

To the Committee on Publications.

Gentlemen:—On the 17th of December, at 6½ o'clock, P. M., the steamer "Knoxville," lying at the levee, exploded two (of her four) boilers, destroying many lives, and making a complete wreck of the boat, and also doing much injury to the other steamboats in the vicinity. Owing to the lateness of the hour, there were but few persons on the wharf, none of whom were injured. The "Knoxville" had undergone a thorough repairing, including patching the boilers;—it appears the boilers were frequently repaired during the last running season, and the inspector's certificate was given of their being in good order.*

The boat was about starting on her first trip, the steam had been up and blowing off freely,† and for some time before up to about 10 minutes

* In justice to the Inspector, I send you his deposition, taken a short time before the explosion, on a trial had to recover the cost of repairing these boilers; the exploded parts of the boilers do not support his opinion of the rivets, as *remarkably* few are broken, the sheets in the laps being torn from them.

†To prevent misunderstanding, it is very rarely the practice to allow steam to escape through the safety valve; instead, the steam and exhaust valves of one end of the cylinder are raised, and the steam blows through and out of the escape pipe.

prior to the explosion. The boat was fast by her head-line to the wharf, both engine-cranks were at right angles, and the cam-rods hooked in ready for backing, but the engines were not in motion. The second engineer, who was on duty at the time, had given orders to *fire up*, and the firemen were doing so; he was seen to try a gauge cock, and immediately after start the "doctor," (*which had not been in motion for a long time before,*) and as soon as the pumps began to work, the explosion took place. The first engineer, who had been up arranging the bell signals with the pilot, was descending at the time, and escaped with slight injury.

After the explosion, the boat took fire; this was extinguished by the water from the boilers of the "Martha Washington"—the end of the blow-off pipe being broken off, the steam forced all the water through it on the deck of the "Knoxville."

The diagram, Plate II., gives the position of the boats at the levee. A, the "Knoxville;" B, the "Martha Washington;" C, the "Griffen Yeatman;" D, the "Ne Plus Ultra;" E, F, the line of the levee.

Appearance of the "Knoxville" after the explosion.—All of the main deck which was under the boilers, and most of the guards, are destroyed; everything overhead, forward of the engines, was carried away, and its innumerable fragments cover the surface of the water and the adjoining boats. The hull was so much injured as to cause it to fill with water, and it was only prevented from sinking by great exertions. On a piece of the larboard guard rested (in good order) a boiler 8 feet long and 30 inches in diameter, which had been used to drive a small engine for hoisting freight out of the hold; this had no connexion with the other boilers. In the cavity of the hold, along with the rubbish, was a piece ($6 \times 12\frac{1}{2}$ ft.) of the shell of a boiler, flattened out to nearly a plane surface; the steam drum, which extended across the top of the after ends of the boilers, is scarcely injured; it lies nearly fore and aft; part of a flue, slightly oval, is in the hold; one end being under the water. A piece of shell, (6×7 ft.) flattened out, is a little forward of the breach on the main deck, and a small piece, about 2 feet square, is on the top of the "breaches," (of the chimnies,) which, with part of the chimnies, and fragments of the fire front, bricks, &c., cover the forward part of the deck; and also the large bell which was on the hurricane deck,—it and the captain (who was ringing it at the time of the explosion) being landed on the forecastle, without injury to either.

The "doctor" is almost destroyed; it is partly turned over; alongside of the larboard engine lies a piece (see fig. 2) of a boiler, about 4 feet by $12\frac{1}{2}$ feet; it has several pieces of the cast iron half-head still fast to it. A little ahead of this piece, lies about nine feet of collapsed flue, bent thus in its length. The heaters, steam pipes, and engines were slightly injured. A (new) manometer or pressure gauge was in good order; its cock communicating with the steam pipe was open at the time; the range of the scale was 160 lbs.; that is, *it* would indicate no higher.

On the starboard side of the boiler deck of the "Martha Washington," at *b*, is a part of the standing pipe which supports the after end of the boiler, and through which the supply water from the pumps enters the boiler. One inside boiler, 26 feet long, and 42 inches diameter, left the "Knox-

ville" nearly at right angles, and, after breaking the guard of the "Martha Washington," its forward end passed upward and through the cabin of this boat, leaving a breach about 12 feet wide, and thence on, making its way through the side of the "Griffen Yeatman," and landed in the ladies' cabin bottom up; the shell is uninjured, except the holes of the joint of the standing pipe, the bolt-heads having been drawn through the sheet. What was the larboard flue is collapsed, and half of the back end is torn from the head. I was prevented, by the officers of the boat, from giving this boiler as thorough an examination as I wished. At *c*, on the side rail of the main deck, hangs the safety valve, the ends of the pipe connecting it with the *two middle* boilers;—for it is usually so attached, instead of being on the steam drum, where it would have direct communication with *all* the boilers; the lever, slightly bent, has the large weight on its extreme end, and the iron lever fixtures for raising or holding it down.

The larboard outside boiler took its flight from the boat, end on, at an (horizontal) angle of about 120° from the course taken by the other boiler; at about 235 feet, at *d*, it dropped some pieces of light sheet iron; 60 feet further, at *e*, it came in contact with the ends of the third tier of barrels of flour, slightly injuring them; 45 feet on, at *f*, it passed through another pile of barrels, destroying many down to the first tier, and scattering the flour over a large surface. Here it diverged about 18°, and it continued on about 200 feet more, passing between two posts; and stopped at *g*, without disturbing the surface of the ground on which it lay.

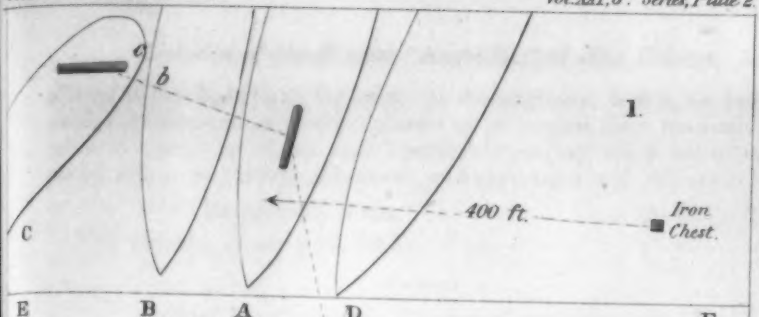
This boiler is partly on one side, and is curved in its length and slightly flattened; it is much strained, and gives evidence of very inferior iron; the highest water line is well defined, and is just *even* with the tops of the flues. The starboard flue is in good order; the larboard one is collapsed its whole length, and is partly torn from its after-head. This flue has been partially overheated; a part of the shell at *m*, fig. 3, (being the outside,) has been overheated for about five feet; it is very irregular on the surface. There are many indentations, forming right angles, made by the rivets of the other boilers, (similar to those shown in the drawings of the "Louisiana,") and cuts or grooves, thus starting from an indentation, and also many straight grooves. All these have been made from the adjoining boiler *leaving its bed first.* At the front end at *h*, is the joint of a small steam pipe; the grummets under the nuts show no signs of extra heat at this part, as the fibres of the hemp is not harmed. At *i* two rivets are out, and cracks from hole to hole; at *k* the edge of the sheets is open (at places $\frac{1}{8}$th of an inch) nearly two-thirds around the boiler; at *l*, undulating and cracks; *m*, crack in the line of rivets for five feet around the shell, four rivets are out. This part is flattened, and has been very hot.

The boilers are said to be only three years old. These prove that age is no criterion for soundness. I have seen better after having been in use twenty years. The heads are half wrought and half cast iron—a very objectionable plan. The boilers have had very bad usage; some of the iron is full $\frac{1}{4}$ in. thick, and part is but a little over $\frac{1}{8}$ in. in thickness; ranging in quality from very bad to good, (the samples are about the best.) Fig. 2 is full of holes and cracks, the bolt heads having torn

the pieces out at *n*, which was the larboard chock joint; the blue lead of the joint is in good order. In the starboard chock *p*, or water communication between the boilers, the blue lead of the joint has been *melted* out. Three pieces of the cast iron head is still attached to the shell. I send you a piece $\frac{1}{8}$th of an inch thick from *a*. Fig. 4 shows nearly all of the half cast iron head, with a piece of the shell attached; this was a top half, and of course received no injury from the action of the fire; the sample sent was cut from the part marked *r*.

The *gas* theory having almost evaporated, we have now, par excellence, "the state of the atmosphere," given as a *reason* for explosions; but in this instance I feel safe in stating *the causes were, defective boilers, a deficiency of water, and ignorance on the part of the management.* That the water was low, is evident from the sharp sound of the explosion, and from the almost perfect boiler in its passage through the cabin of the "Martha Washington," scarcely soiling the white paint by water; none was discharged on the "Griffen Yeatman's" deck, or remained in the boiler; neither did the other boiler discharge any water in its track over the land. It also was dry. After the explosion, I conversed with men who had stood abreast of the boilers, on the larboard side of the "Knoxville," and on the guard of the "Ne Plus Ultra," who were only partially scalded. Some who escaped uninjured were soaked with water, without being scalded. This may be accounted for by the deck freight, and other heavy articles, being thrown overboard, causing the river water to splash up and wet them. The water line, as seen in the boiler *s*, shows that the stupid and dangerous practice of carrying the water just above the flues was the custom on this boat. The blowing off of steam for a long time, and no water being pumped in to keep up the proper supply, it wasted away until it had got low enough to permit parts of the boilers to get dangerously hot; then setting the pumps to work and throwing in water, caused a wave to be produced, which, flowing over the overheated portion of the boilers, flashed into steam, and their destruction followed the sudden increase of pressure.

I will enlarge on what I stated in the case of the explosion of the "Louisiana," namely, "showing off" in front of the city, (this is the practice at all the principal points on the river.) The pernicious influence of this custom has been the cause of all the explosions at this landing within my recollection. Along with the uncertainty of the time of starting, (for the hour appointed in the advertisements is only a deception,) this "showing off" induces many to keep up steam to the highest point for hours before the time of leaving, and as many, having pretensions to the name of engineer, carry the working surface of the water just covering the flues, and the steam as formed being allowed to pass off freely, as before mentioned, through the escape pipe of the engine, in many cases the water (as is common) rises and follows the current of steam, and it is found when too late that the water is dangerously low; fear of the loss of their situation prevents their extinguishing the fires, and they brave the risk. Good engineers are under the influence of this bad practice, for if they left the landing with slow fires, and as a consequence the boat did not do its best at the start, their reputation would suffer, for here the speed of the boat in passing the landing is considered by many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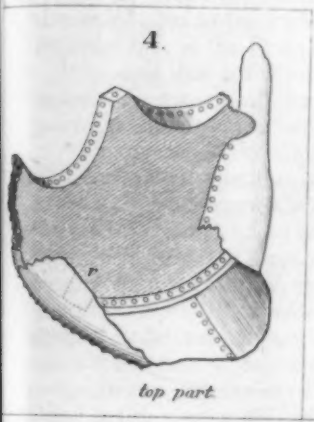
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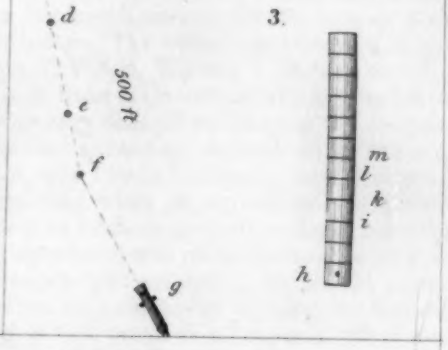
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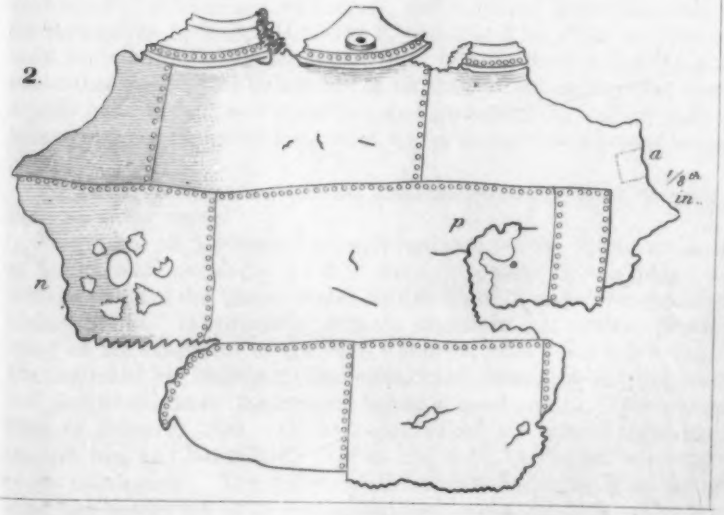
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a test (of the boat,) and the merit of the engineer; hence, as long as public opinion compel good engineers to go against their convictions of what is right, the cheap and worthless ones (and there are too many such) will do so through ignorance, and explosions will still occur.

Respectfully yours, A. C. Jones.

New Orleans, January 10, 1851.

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*Judicial Investigation in the case of the "Knoxville."**

We lay before our readers the proceedings of a late judicial investigation in relation to the boilers of the steamer Knoxville, had before Judge Strawbridge, of the Fourth District Court.

It appears that in February last, F. Coan & Co. of Algiers, brought suit against the owners of the steamer Knoxville for the sum of $360 for patching and repairing her boilers. The defendants answered as follows:

"The answer of William A. Violett, William T. Duncan and Thomas C. Charles, to the petition of F. Coan & Co. respectfully shows, that except as far as hereinafter admitting, they deny all and singular the allegations of plaintiffs' petition. And further answering, respondents further say, that they, with Briggs & Cramp, who live in Vicksburg, were owners of the steamboat Knoxville at the time when an agreement was made with plaintiffs respecting repairs to be made to the boilers of said boat; that the express understanding and agreement with plaintiffs was, that they should make the boilers of said steamer tight and sound, and should receive no compensation whatever unless they succeeded in doing so; that said F. Coan & Co. were made aware that previous attempts of others to make said boilers tight had not succeeded, and were told to examine and judge for themselves before undertaking it, and that if they did undertake it, it must be upon the aforesaid condition of making them perfectly tight and sound that they should be entitled to any compensation therefor; that they wholly failed to fulfil said condition, and are entitled to nothing under their agreement; that moreover their work was of no service or benefit to respondents."

We make the following extracts from the testimony taken in writing on the trial of the cause:

Joseph Lovett, a witness for the defendants, sworn—"I am an inspector of boilers and machinery for this State, appointed by the Judge of the District Court of the United States for this District, under the statute of the United States. Is acquainted with the steamboat Knoxville. She is now lying on the other side of the river, where he visited her a few days ago. He inspected her boilers on the occasion of these repairs being made to her, and he thinks he then passed her as in good order. This was on the 28th of January, 1850. He has been called on several times since to inspect her, and has refused to pass her, until her boilers were repaired to his satisfaction. The defects of the boilers are in the iron; the iron is hard and brittle; the rivets brittle also, and small, and leak. Don't know that he examined all the iron, but examined such parts as were cut out. There are other parts of the boilers that now require to be cut out before

* From the New Orleans Picayune.

he can pass them. Don't know that he could pass them then, unless he was satisfied with the remainder. A boiler might be tight to-day and to-morrow might blow up, by the carelessness of the engineer. Should think that they had succeeded in making the boilers tight, but the old iron was brittle, and would not hold the rivets without leaking. There are many reasons why a boiler maker should not warrant a boiler—a boiler might be blown up, burnt out, or strained by the carelessness of an engineer, and it would be in the power of the owner in that way to keep the maker out of his money as long as he liked."

Alexander Ballantine, a witness for plaintiffs, sworn.—"Is a boiler maker, and has worked at the business for five years. Worked on the steamer "Knoxville" for plaintiffs. Believes the work to have been a good job, considering the state of the boilers; the boilers were old and many cracks in them; the old boiler iron was very hard and many flaws in it. The boilers were in pretty good order, or appeared to be, when they quit working on them; there were some other places in the boilers which the engineer said he would have repaired; that he had not time then to have it done. Witness worked on the boilers twice. The second time the boat came in, they took out several rivets, opened some seams, and put new rivets in. Ten new pieces were put on the first time. The engineer said she leaked afterwards. Saw the marks of the steam on the iron the second time we worked on her. The boilers had either been strained or not well built in the first instance."

James Whiting, witness for defendants, sworn.—"Was carpenter on the 'Knoxville' when the contract to repair the boilers was made with plaintiffs. Mr. Duncan, one of the owners of the boat, acted on behalf of the boat with Mr. Coan in making the contract. Witness noticed the state of the boilers after they were repaired. They leaked as bad on the first trip as before. Whilst witness was on the boat, plaintiffs worked on the boilers nearly every time she came to town, and the new work leaked nearly as bad as the old."

The court, in giving judgment against the plaintiffs, said:—"I am satisfied that the plaintiffs did their best, and were not deficient in skill, but that their failure was owing to a radical defect of the iron of which the boilers were originally made, and could have been made tight by no skill whatever."

This decision was rendered only on the 2d instant, and has not yet been made final, as a motion is now pending for a new trial.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 20, 1851.

Samuel V. Merrick, President, in the chair.
Isaac B. Garrigues, Recording Secretary.
Solomon W. Roberts, Corresponding Secretary. } Present.
John F. Frazer, Treasurer.

The minutes of the last meeting were read and approved.

Donations were received from Hon. John Robbins, Jr., U. S. Congress; J. J. Greenough, Esq., Washington City, D. C.; The Mercantile Library Association, St. Louis, Mo.; The Mercantile Library Association, City of New York; and Messrs. E. & J. Biddle, Solomon W. Roberts, and Zebulon Parker, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of January was read.

The Board of Managers and the Standing Committees reported their minutes.

Candidates for membership in the Institute (16) were proposed, and those proposed at the last meeting (4) were elected members of the Institute.

The Standing Committees for the ensuing year were nominated by the President, and appointed as follows:

On Library.	*Cabinet of Models.*	*Exhibitions.*
John Allen,	John Agnew,	John E. Addicks,
George W. Farr,	H. P. M. Birkinbine,	John C. Cresson,
George Harding,	Joseph J. Barras,	George W. Conarroe,
George P. Herse,	Henry Huber, Jr.,	Owen Evans,
William S. Levering,	Robert Lindsay,	James P. Ellis,
William A. Rolin,	J. Vaughan Merrick,	Thomas Fletcher,
Jacob D. Sheble,	Prosper Martin,	Henry H. Kelly,
Charles E. Smith,	Thomas S. Stewart,	William D. Parrish,
George P. Whitaker,	Clement W. Smith,	John H. Towne,
Dr. Geo. J. Ziegler.	Thomas U. Walter.	Alan Wood.

Cabinet of Minerals and Geological Specimens.	*Cabinet of Arts and Manufactures.*	*Meetings.*
M. H. Boyé,	James C. Booth,	Joaqim Bishop,
Edwin Bishop, Jr.,	John C. Copper,	J. M. Cardeza,
John F. Frazer,	James Euston,	B. B. Gumpert,
Wm. W. Flemming,	Charles M. Ghrisky,	Dr. B. H. Rand,
Edwin Greble,	William Harris,	George W. Smith,
Dr. B. H. Rand,	Peleg B. Savery,	Return Sheble,
Dr. L. Turnbull,	William P. Troth,	Dr. L. Turnbull,
John C. Trautwine,	Gustavus L. Thomas,	John Thornley,
R. A. Tilghman,	Isaac S. Williams,	Elisshib Tracy,
Dr. C. M. Wetherill,	Thomas J. Weygandt.	Dr. C. M. Wetherill.

Meteorology.

D. R. Ashton,	J. A Kirkpatrick,
Samuel W. Black,	James S. Lippincott,
Dr. S. S. Brooks,	B. B. M'Kinley,
Owen Evans,	Charles S. Rand,
L. C. Francis,	John Simmons,

Mr. G. W. Smith made some remarks respecting the fracture of the centre-shaft of the steamship "Atlantic," stating that similar accidents were by no means unfrequent in British, American, and other steamers, citing instances in confirmation. He then adverted to the mode of manufacture of large masses of wrought iron by the hammer, showing that, when flat bars were laid upon each other, the scale would not always escape from between them, being detained by the adhesion of the edges.

He described the remedy of Mr. Nasmyth,—giving a curved surface to the bars, whereby the adhesion is first produced at the centre, and the scale driven out before the outward edges come into contact.

Mr. Angus Macpherson, of Scotland, confirmed the statements as to the frequency of such accidents in English steamers, and described at length the method of arranging the bars radially on a triangular swage, in the manufacture, for the purpose of forcing out the scale.

Some discussion took place between Mr. Prosper Martin and Professor Frazer, respecting the properties of bars of iron when covered with copper, and the process of welding them attempted. The nature of the compound (alloy?) was also discussed, and a specimen of it for the next meeting was promised.

The disclaimer of Messrs. Stillman, of the Novelty Works, as to all responsibility in forging the centre-shaft of the Atlantic, which was not done according to their plan, was mentioned by the chairman. The subject was further discussed by Messrs. Sewall and Williamson, Engineers U. S. Navy, and Messrs. Bartol and Towne, who concurred in the views expressed.

Dr. Charles M. Wetherill presented the following analysis of the bitumen from Pictou, N. S., presented at the last meeting:—

The specimen handed me was of fine, black, glossy appearance, of conchoidal fracture. Density, 1·09; streak, black. The hygroscopic moisture was ascertained by heating in an oil bath to 120° C. The volatile combustible matter was then determined by raising to an incipient redness with covered crucible. The fixed carbon was determined by exposing to full red heat with uncovered crucible. As a black, porous, metallic coke remained with the ash, which was not burned away by long exposure to heat, the incrineration was completed by covering the crucible, and introducing a slow current of oxygen. Although this part of the analysis was performed with great care, it was impossible to avoid a slight loss of ash. The results of the analysis are as follows:—

Hygroscopic moisture,	00·31
Volume of combustible matter,	59·32
Fixed carbon,	40·23
Ash,	00·14
	100·00

Mr. Smith mentioned the recent discovery of bituminous coal in large quantities in Puget's Sound, Oregon, and adverted to the vast importance of this mineral in that locality,—being the first discovery of true coal in our territory on the Pacific. It had formerly been supposed that the deposit of lignite, or brown coal, extended from Chili to the Arctic Ocean,—a length of formation without parallel in the globe. The discovery of true coal at two, if not three, points remote from each other, interrupts this continuity, as is now seen.

Mr. G. W. Smith described the plans of Major Bache of the U. S. Topographical engineers, for the formation of ice harbors in the Delaware by means of Mitchell's screw piles, which present an obstacle to the passage of ice in large masses through such harbors, leaving the water way clear, and thereby preventing the deposit of silt, a never-failing result of solid piers, even when sluices are employed in the common manner.

The injurious changes which have taken place in the Delaware and other tide-water rivers, from the contraction of the stream producing immense deposits above and below such piers, were described at length, and the

unscientific manner in which successive Boards of Wardens of the Port had authorized such obstructions was alluded to, and the importance of entrusting such functions solely to Boards of Engineers insisted upon. The capacity of screw piles to resist ice was illustrated by three years' experience at the Brandywine Screw Pile Lighthouse, in Delaware Bay, and their more general introduction for a variety of purposes strongly urged. The stability of the lighthouse on Minot's Ledge, near Boston, was also insisted upon, notwithstanding some exaggerated reports of its unstability which had been published in the daily press, the errors of which were pointed out. The causes of the destruction of the iron pile lighthouse on Bishop's Rock, off the Land's End, England, while in an incomplete state, were explained as by no means militating against the stability of such structures when properly made. Roman harbor piers in various parts of Italy, composed of piers and arches, permitting a flow of water through the harbors for the prevention of silt, were described, and especially one near the ancient Puteoli, were given from the examination made of them by the Chairman,—the piers being founded in a greater depth of water than any other structure on the globe,—about 126 feet.

Messrs. Yerger & Ord, of Philadelphia, presented the following case and remarks:—

This case is that of a gentleman born without feet, leaving stumps below the knee measuring 5 and 7 inches, which deficiency of nature had been supplied by a *pair* of our *Patent Metallic Skeleton Artificial Legs*. From infancy to the age of about 7 years he had been in the habit of walking on his knees, all fours, and getting about in a manner that best suited his convenience; at the expiration of the above time, his parents, anxious to better his condition, employed a country mechanic, who made him a pair of wooden legs, and after encountering numerous difficulties, he succeeded in gaining sufficient use to hobble about on them in an awkward manner. In December we constructed for him a pair of our most approved limbs, which we applied on the 19th of this month, (February.) The result has been most satisfactory. He now walks with great *comfort*, *ease*, and considerable *rapidity*, ascending and descending a flight of stairs, one foot over the other, without much difficulty.

The cut is a representation of the leg. It is constructed of a series of cast-steel ribs and rings, each of which have a curved or semi-circular form, framed and united upon the principle of a lattice bridge or arch, one piece bracing and sustaining the other, imparting a great amount of strength and durability, and at the same time exceedingly light; the part below the stump being entirely open, prevents any accumulation of hot air, moisture, and consequent ulceration of the stump. The foot is made of wood, with the natural action at the ankle and toe joints; the whole arrangement is so much simplified that it requires but little or no attention on the part of the wearer to always have his leg in good working order.

Dr. Chas. M. Wetherill made some remarks on Drayton's mode of silvering glass.

A specimen of a double bottle and stopper, made by Varnish, of London, silvered in the interior, it is believed, by Drayton's second process, (sealed December 4, 1848—see Journal Frank. Inst., Vol. XVIII., 3d series, p. 217,) was presented, and much admired. The blue glass of the greater part of the exterior was sufficiently opaque to conceal the silver ornamented cavities ground into it to a depth sufficient to reveal the inner colorless glass, thereby displaying the brilliant silver beneath to great advantage.

Mr. G. W. Smith stated that he was now enabled to present to the Institute an account of the aggregate extent of all the railways in the United States which are finished, including those which will require the present season for their completion. They amount to the enormous extent of ten thousand six hundred and eighteen miles. If the additional extent of those which will certainly be finished in the ensuing year be added, the extent will be upwards of twelve thousand six hundred miles, more than sufficient, if in one line, to reach round more than half the circumference of the globe, and exceeding the extent, in the aggregate, of all railways in the residue of the globe.* Mr. S. had been for many years engaged in these researches.

Mr. Solomon W. Roberts said that he concurred in the opinion of Mr. Smith as to the number of miles of railroad which would be in use in the United States in the course of next year. He had studied this subject in the West with a good deal of care, and he would say that it was difficult for those who were only acquainted with the costly railroads constructed east of the Allegheny mountain, to appreciate the cheapness with which good railroads can be made in the States west and northwest of the Ohio river. In his opinion, in less than three years from the present time, there will be a continuous line of railroads from Philadelphia to the Mississippi river, at St. Louis, and also by Chicago, on Lake Michigan, to the Mississippi, at Galena; each line being more than a thousand miles long. He made some remarks upon the feuds and faction fights among the Irish laborers, and stated that on the Ohio and Pennsylvania Railroad, of which he is the Engineer, the great body of the laborers are Corkonians, and there has been but little difficulty in keeping good order, except in a few instances where contractors have employed men from different parts of Ireland on the same section.

Mr. J. Z. A. Wagner, of Philadelphia, presented a model of a feathering-blade propeller, the action of which was reciprocating, resembling the motion of two oars wholly immersed in the water.

The hour having arrived for adjournment, and the business of the evening not being concluded, the meeting adjourned until Tuesday evening, for the purpose of discussing the relative value of side wheels and propellers, as instruments of propulsion for steamers.

* It is not improbable that between four and five hundred miles in addition may be finished by that time, but are not included in this estimate.

COMMITTEE ON SCIENCE AND THE ARTS.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to examine a "Magnetic Gauge, for indicating the height of water in Steam Boilers," invented by Mr. George Faber, of Canton, Ohio,—REPORT:—

That they have examined the construction and operation of the same, and consider it to possess the following advantages:—Simplicity of construction and operation; freedom from friction, no portion of it working in a stuffing box; durability as to time of use—some that have been used four years are as perfect and act as well as when first put up.

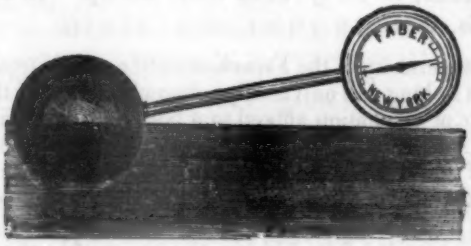
It indicates the exact height of water in the boiler, and the indication is visible. It indicates its own derangement, for when not working properly the needle becomes fixed, while it has a slight tremor when in action.

Considering this gauge to possess the above advantages, and having tested it for nine months accurately, on a tubular boiler using 80 lbs. of steam, the Committee confidently recommend it to general use, considering it a valuable improvement, and one that will conduce to the safety of steam boilers in general.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, February 13, 1851.



Description of Faber's Magnetic Water Gauge.

The gauge consists of so few parts, and is so extremely simple, that a glance almost at the drawings will serve to make it understood. It consists of a heavy copper sphere or ball, made to withstand the required pressure; this ball floats on the water inside of the boiler, and is attached to a brass rod, cranked near one end, which passes through a long pipe or journal, terminating in a circular plate. The end of the rod extends a short distance beyond the plate, and is fitted to receive a steel magnet, having its positive and negative poles. The cranked end of the wire plays in the journal with perfect freedom, having *no stuffing boxes or packing of any kind about it;* hence there is no friction.

Outside of the circular plate there is a cap fitted to screw on, forming a chamber for the magnet to work in. The front of this cap has a recessed space, on the front part of which a dial or index is put. A pin projects from the centre, on which a steel needle is placed, and at the outer edge of the rim a glass shade is secured to keep out dust, &c. The instrument is put in operation as follows: First, find a proper spot on the front of the boiler to place the index or dial; this should be a little above the range of the place where the middle cock is ordinarily put. See that from this place there is room for free play of the copper ball inside the boiler. Then drill a hole through the spot selected, large enough to receive the stem or pipe to which the index is attached; pass this stem through and set up the pinch nut on the inside, pack the outside nut with a pasteboard washer against the boiler, screw on the dial cap, and make a *tight joint* where it meets the circular plate.—Shoe-thread wound a few times round, or fuller's pasteboard will answer: *but remember, put no lead or other cement anywhere on the gauge.* Screw on the ball and fill up the boiler, adjust the dial and float so that the needle will lie horizontally, when the water is at